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AMERICAN MACHINIST

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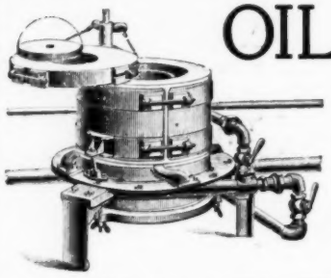

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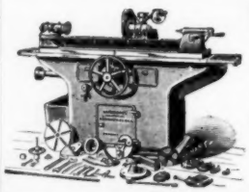

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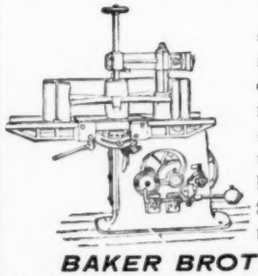

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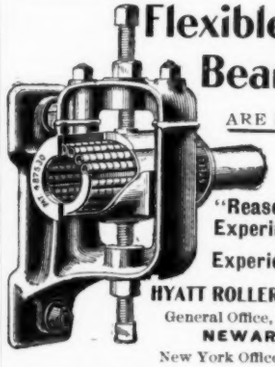

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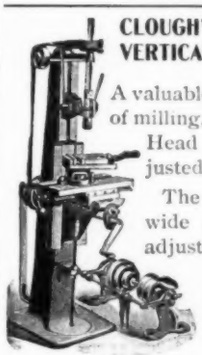

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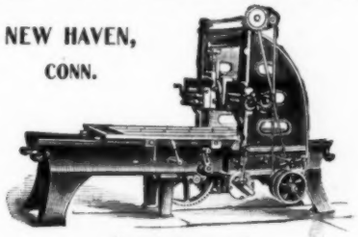

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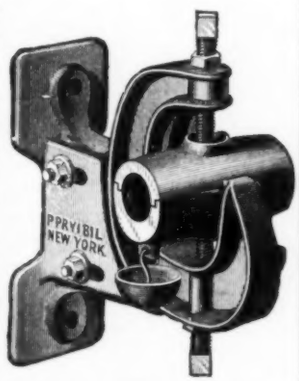

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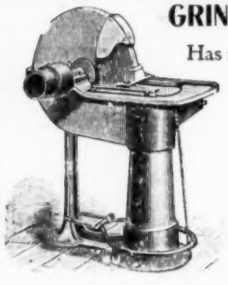

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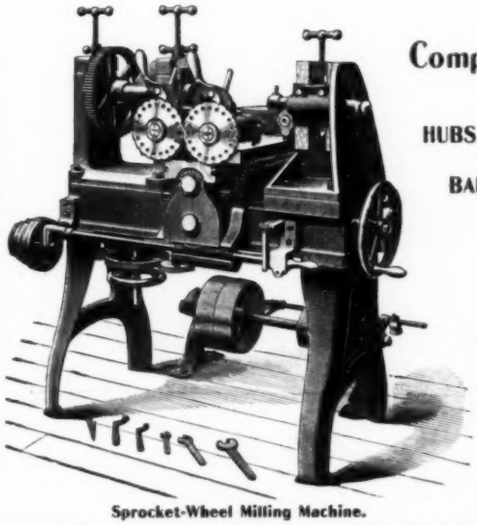

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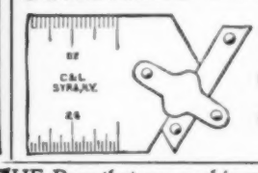

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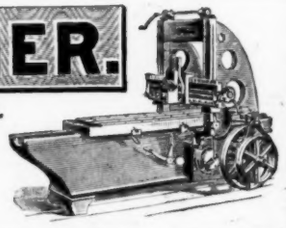

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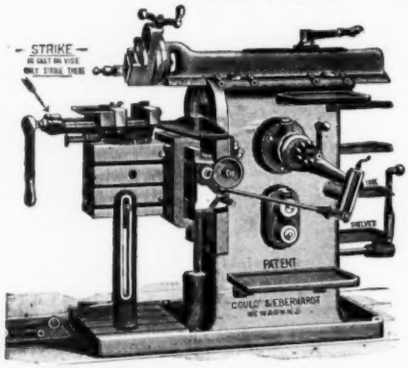

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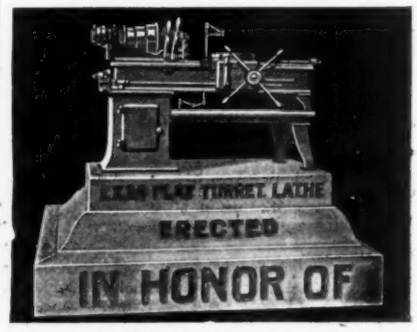

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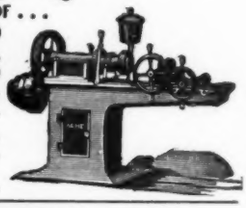

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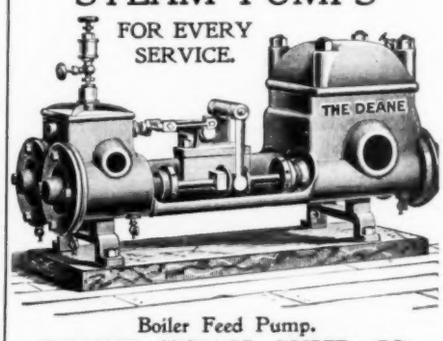

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A Machine Shop that Was Moved—New Work for Machinists—A Key-Seating Tool—Fan Blowers and Electric Motors—A Modern Journal Box—Drilling Split Pulleys.

Machine shops do some very strange things these days, Mr. Editor—things which a few years ago would not only have seemed impossible, but would actually have been entirely beyond the range of possibility at that time. Ever since you mentioned in the "American Machinist" that job of shop-moving done by the

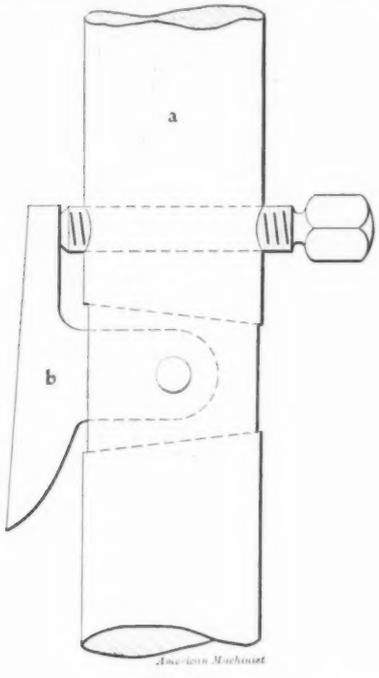


Fig. 1

B. F. Sturtevant Co., of Boston, I have had a desire to see that shop and the man who planned the work.

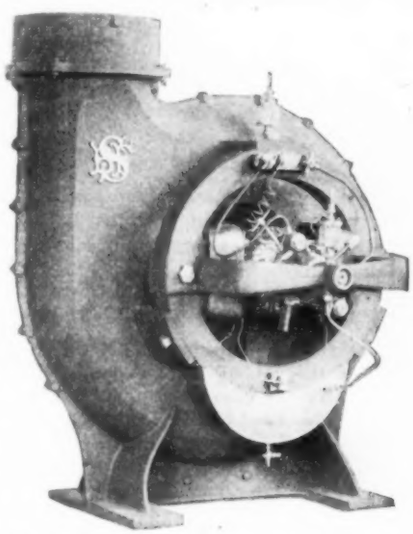
It will be remembered that the shop was moved to make room for the great work being done by the New York, New Haven & Hartford Railroad in elevating its tracks above the street level. The movement of the shop was about 300 feet in one direction and 50 feet in another, and was effected without suspending work, the shop being operated all the time, just as though nothing unusual was going on. The building is of brick 350 x 50 feet. About one-half of its length is three stories high and the rest two stories. Electric motors were attached to the shafting; wires were led to them from a generating plant put in for the purpose; and thus this large brick shop was not only moved bodily through a distance of 350 feet, but it was kept in operation during the transition—which was particularly desirable, on account of a rush of business.

NEW WORK FOR MACHINISTS.

The very rapid advances which have been made within the past few years in the art of heating and ventilating shops and other buildings, as well as naval and merchant vessels, have been an important factor in the business of this concern; besides which, this is one of our American shops, the proprietors of which have fully realized the importance of foreign trade, and, by establishing their own house in London, have built up a business over there which by itself now amounts to more than the entire business of some concerns engaged in similar lines here, but which have not pushed foreign business so vigorously—a fact which, it seems to me, speaks volumes in favor of the now quite general movement of American machine builders to secure business in other countries.

Walking through the shops with Mr. Blake, of the engine and motor department, I found them much better arranged now than before the remarkable move referred to, which gave an opportunity for rectifying the objectionable features which it had seemed impossible to avoid when the shops were extended from time to time to give capacity for increased business. And it is an impressive fact that a very large part of this increase of business has been in the line of machinery which is being put in to do work that was not done at all a few years ago, and which at that time nobody thought of doing. Here is a concern which is not usually thought of as a builder of engines, and, in fact, does not pretend to figure in the general engine market; yet it is making from 600 to 700 engines per year, and it is safe to say that, scarcely without exception, these engines are for doing work which a few years ago was not done at all, either by engines or otherwise, and which the necessity or importance of doing was not in the least realized. Large numbers of them are direct-connected to blowers and exhaust fans, which force cold or heated air into shops and other buildings, thus insuring efficient ventilation and at the same time absolutely controlling temperature. Others are used for forced blast on naval vessels, and, as an example, there are fifteen of them, varying from 20 to 80 horse-power, on each of the American Line steamers "St. Louis" and St. Paul;" five for electric lighting, eight for forced blast, and two for ventilating and heating, i. e., for forcing into each state-room a supply of either cool or heated air, as may be desired by the occupant.

Another example of a new use for an engine is to be seen in the boiler house of the Sturtevant shop, where no stack is



ELECTRICALLY-DRIVEN FAN BLOWER.

used, but, instead, simply a short funnel through which the gases of combustion are forced by a fan which is driven by a small direct-connected vertical engine; the whole standing upon a platform over the boilers. The throttle valve of this engine is controlled by a mercury column, and this mercury column is acted upon by the steam pressure in the boilers, which, if it changes so much as a pound, alters the speed of the engine, and thus produces more or less draft, as may be desired. The whole affair is exceedingly simple and mechanical, and

is very efficient in maintaining uniform pressure; though I believe the relative economy of it, as compared with natural draft, has not yet been fully determined. They are burning a mixture of crushed coke and coal, which is so small in size that it looks as though something more than natural draft would at times be required to make it burn well.

The operations carried on in the machine shop are not especially remarkable, and little is to be seen outside of ordinary good practice where interchangeable work is made. Interchangeability is looked after closely, and parts of engines, especially the smaller ones, are made in quantities and kept in stock to be used as required. This is especially important with many of the engines that go into steam vessels, where extra parts are usually supplied that must be ready to attach at any moment in case of a break-down.

A KEY-SEATING TOOL.

Considerable key-seating is done, and a drill-press is used for the job, equipped with a cutter bar like that shown in the sketch, in which *a* is a short section of the bar, and *b* the tool, which is shaped about as shown and is as thick as the width of the key-way to be cut. The cutting edge of the tool is at the bottom, and after each passage through the hub of the wheel or pulley the set-screw shown is backed out a little for the next cut, until the required depth is obtained. Originally there may have been a spiral spring somewhere to keep the cutter up to its place and against the end of the set-screw, but when I saw it the plebeian rubber band of commerce performed that important office, by being stretched around the bar and over the upper end of the cutter.

I believe this beats the chisel and file, even where there is only a limited amount of key-seating to do; but where there is much of it to be done, the requirements of modern practice would call for a key-seating machine.

FAN BLOWERS DRIVEN BY ELECTRIC MOTOR.

An excellent example of the usefulness and adaptability of electric transmission of power is to be found here, in the shape of fan blowers driven by electric motors attached directly to the side of the casing. The beauty of this arrangement is that the natural and proper speed of the motor armature and of the fan is the same, and consequently the armature shaft is also the fan spindle. Then such an arrangement can be placed anywhere that can be reached by a wire, and can work in any position about equally well. It occupies relatively small space, makes little or no noise, and carries no heat, as steam would. Such a fan can be placed and can work successfully in places where a fan driven by an attached engine, or by belts, would be utterly inadmissible, and the machine is a good example of how work is being made for machinists in building machines (and engines to drive them) for doing work which was, a short time ago, not only left undone, but which could not have been done at all without electric transmission.

Among the curious fans which I saw here were some that had casings made of lead instead of cast iron, and these are used for handling the vapor of acids which would quickly destroy an iron casing. Other fans were being made for handling loose cotton and delivering it where wanted, along with a current of air.

A MODERN JOURNAL BOX.

In the near-by shops of the American Tool & Machine Company I saw some journals which interested me. The blueprint of a piece of machinery built for the New England Machinery Company, to go into the plant of the Passaic Lighting Company at Passaic, N. J., shows some of these journals, and other things as well.

The development of electric machinery has had its effect upon journal bearings, because so many bearings have been called for that must run at high speeds for long periods of time, and which must not be stopped during those periods for any purpose whatever.

Two of these journal bearings are shown at the right of Fig. 2, one being for the transmission shaft, and the other for the sleeve to which the pulley is keyed, and which can be connected or disconnected from the shaft by a friction clutch. Part of this clutch is shown at the left, where the sleeve is shown partly broken away.

The boxes are made in halves, are lined with babbitt metal, which extends around the radial surfaces of the space in which the thrust collars work, and there are small rings of steel wire of half-round section which rest upon the shaft within each bearing, as shown, and carry oil up from below to the top of the shaft. These rings have a joint in them and will spring together like a key ring. Such bearings are said to work with entire satisfaction in this service, and they certainly look it.

DRILLING SPLIT PULLEYS.

They do a drill-press trick in this shop that may be worth noting. I have seen

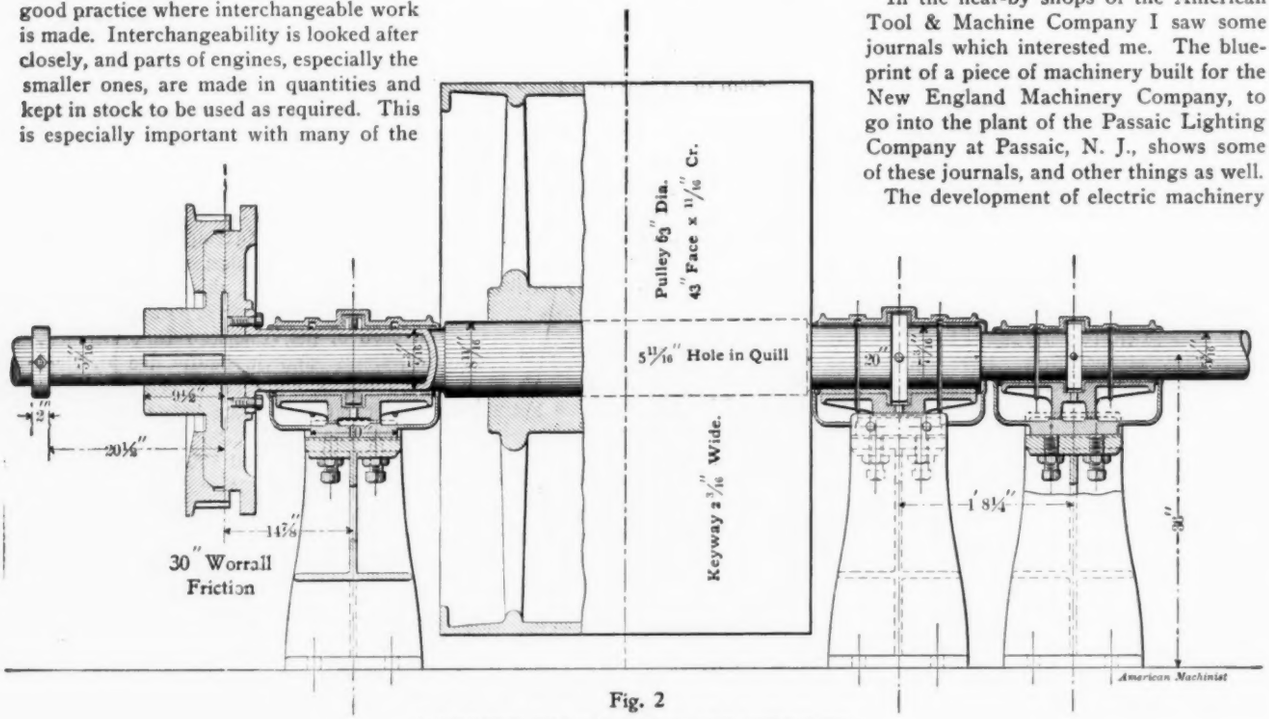


Fig. 2

A MODERN TRANSMISSION ARRANGEMENT.

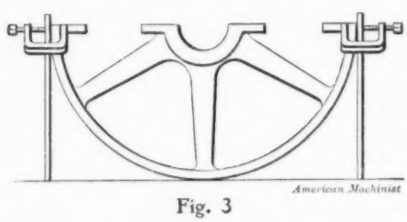


Fig. 3

A PULLEY FIXED FOR DRILLING.

a good many different methods adopted for holding the halves of split pulleys while drilling holes for the bolts that hold the pulley together, but none I think quite so convenient, cheap and generally good as that shown in Fig. 3, where half a pulley is shown fixed for being drilled.

Four straight pieces of bar iron are clamped to the rim of the pulley—one at each corner. The reader will kindly imagine two others behind the ones shown, though in practice they may not be exactly in line, because not much attention is or need be paid to having them stand just vertical. The pulley is leveled up, and the four pieces of square iron to reach to the floor or bed plate, four C-clamps and a monkey wrench quickly do the rest, after which the pulley can be moved about easily, and can be depended upon to keep its proper position, so that the drill-press man can take comfort in shoving drills through, untroubled by fear that some part of the contraption will slip, let the pulley move, catch on the drill, and raise a rumpus.

S. T. FREELAND.

▲ ▲ ▲

We are in receipt of an account of another machine which is to run itself and, in addition, produce power to let. Electricity is to do it this time. The boiler is to have its tubes removed and rods of a new metal inserted in their stead. A portion of the current generated is to be put through these rods, and the heat generated is to take the place of the heat from burning coal, and so produce the steam. A small auxiliary boiler, engine and dynamo are to start the process, after which it is to run indefinitely. We wonder if these attempts to beat Nature will ever cease.

Making Balls for Bearings.

It may or may not be true that all sliding machine surfaces will sometimes be lubricated with hardened and ground and polished steel balls instead of oil, but it is thue that the Cleveland Machine Screw Company, of Cleveland, O., made in the month of January last over 14,000,000 balls of various sizes for use in "ball bearings," and over 16,000,000 in the month of February. In addition to this vast number made under the direction of Mr. John J. Grant (whose name has long been known to the readers of this paper), two or three other concerns also make them, though not, we believe, in such large numbers.

The Grant method is to produce the ball blank by the use of the ordinary screw machine, or rather by the use of a simplified modification of the well known Cleveland Screw Co.'s screw machine, up to ½ inch diameter, and to forge the blanks above ½ inch; these blanks, which are in no case very nearly spherical, are then finished by rough grinding and polishing to perfect spheres, and gaged and sorted and counted by means fully shown in the illustrations herewith, which embrace almost every step in the making of balls at this establishment.

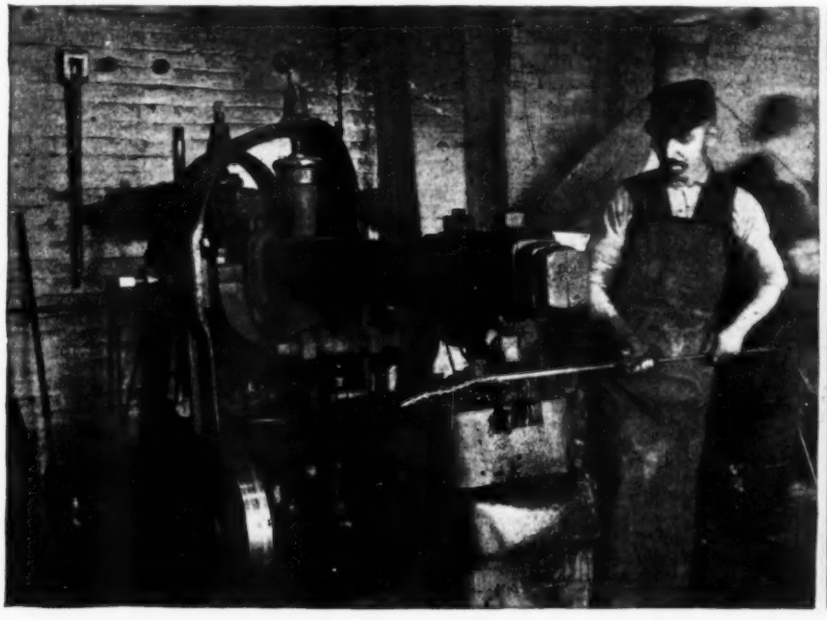


Fig. 1. FORGING BALLS UNDER BRADLEY HAMMER.

Fig. 2. MAKING BALL BLANKS ON SCREW MACHINES.

FORGING BLANKS.

Fig. 1 shows the forging of small balls from a hot rod under the well-known Bradley hammer. The forging is done in dies of quite the usual form, and is a very rapid method of making the blanks. After forging, the hammer man and his helper cut off the balls with a hardy or handle chisel or "axe" and a hand hammer.

Fig. 2 shows the bank of small automatic screw machines nearest the windows in the ball blank screw machine room. These machines are very rapid in operation, and require very little attention; they were especially designed for this work, are incredibly quick in their rod moving and chucking actions; are, of course, swimming in lard oil, and eat up rods of steel with bewildering avidity.

ROUGH-GRINDING.

From the forge and screw machine the ball blanks go first to the rough-grinding machines, and are there rough-ground, mainly into spheres; some of them, however, fall into evil ways, by at once assuming a "peg-top" form which is not by any means spherical, thongh it has a constant diameter when measured on certain lines.

The idea of the rough-grinding machine, Fig. 3, is to place the ball blanks in a circular, open-bottomed, V-groove with a flat revolving ring over them, thus giving the blanks three points of bearing by which they are supported, so that the bottom line of the blank projects a very small distance below the bottom face of the circular ring and circular disk shown in Fig. 4, the beveled edges of which form the inclined sides of the continuous open-bottom ring V-groove before mentioned.

Below this ring there is an annular or "cylinder" grinding wheel of the Norton Emery Wheel Company's make. The sliding head which supports the grinding wheel is arranged with an adjusting screw and dial so as to be readily fed minute distances upward toward the balls. The grinding wheel is not concentric with the V-groove ring, but is so set to one side that as the V-groove ring revolves, the balls will cover more than the entire width of the grinding wheel face, all as

more clearly shown in Fig. 5, which is a hand sketch of the principal ball-blank supporting parts and grinding wheel, and also shows about the average form of rough ball blank as it comes to the grinding machine. It will be seen that this ball is not nearly a sphere; in point of fact, no special effort is made, either with the forged or screw-machine-shaped blanks, to make a close approximation to the truly spherical form which the finished ball must have. It is found cheaper to make the blanks the shape easiest produced and let the rough-grinding machines do the rest.

The general construction and operation of the grinding machine are as follows: size cannot be done by a machine not under constant supervision; the balls are first ground by guess; the guess is close, since the guesser has constant employment; the rough balls are put into the V-groove, Fig. 4, and the top ring is put down on them; the grinding wheel is lifted up to touch the balls, and the grinding begins at once—first in spits of fiery sparks; then, almost immediately, in the steady whirl of fire which indicates that the balls are round and each is constantly on the grinding wheel; then the wheel is stopped, and two or three of the balls are measured in the micrometer *C*, on the stand *D*, Fig. 3, with which each machine is supplied. At this stage of grinding the balls are wear makes any fixed setting of the machine to produce balls of a given diameter an impossibility.

The upper work, above the grinding wheel, consists of a stationary case *E* Fig. 3, in which the revolving ring, Fig. 5, is inclosed or supported, and a spider *F*, to the bottom of which the ring which forms the outside member of the ball-guiding V-groove is secured by three screws, the holes for which are shown in the outer ring member in Fig. 4. All of this work is supported in the adjustable vertical head *G*, Fig. 3. The spider *F* has a short drop which can be given at will by pulling down on the hand lever *I*, against the resistance of the spring *H*,

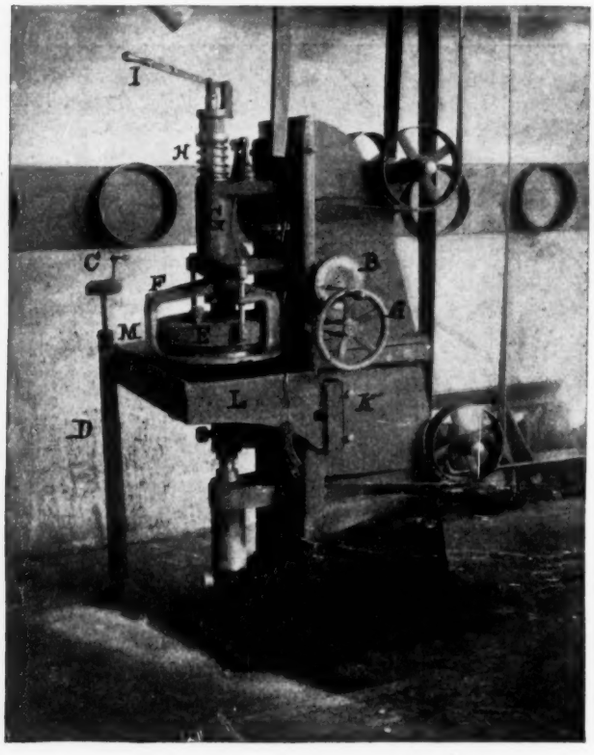


Fig. 3. ROUGH-GRINDING MACHINE.

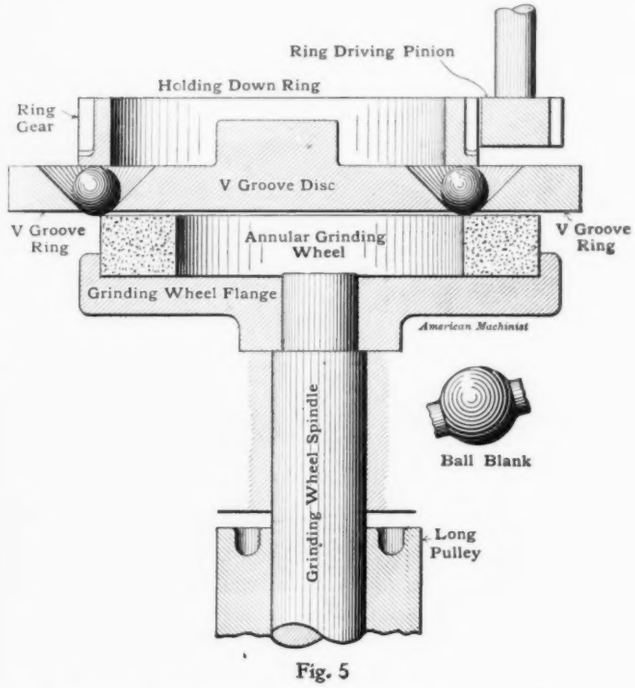
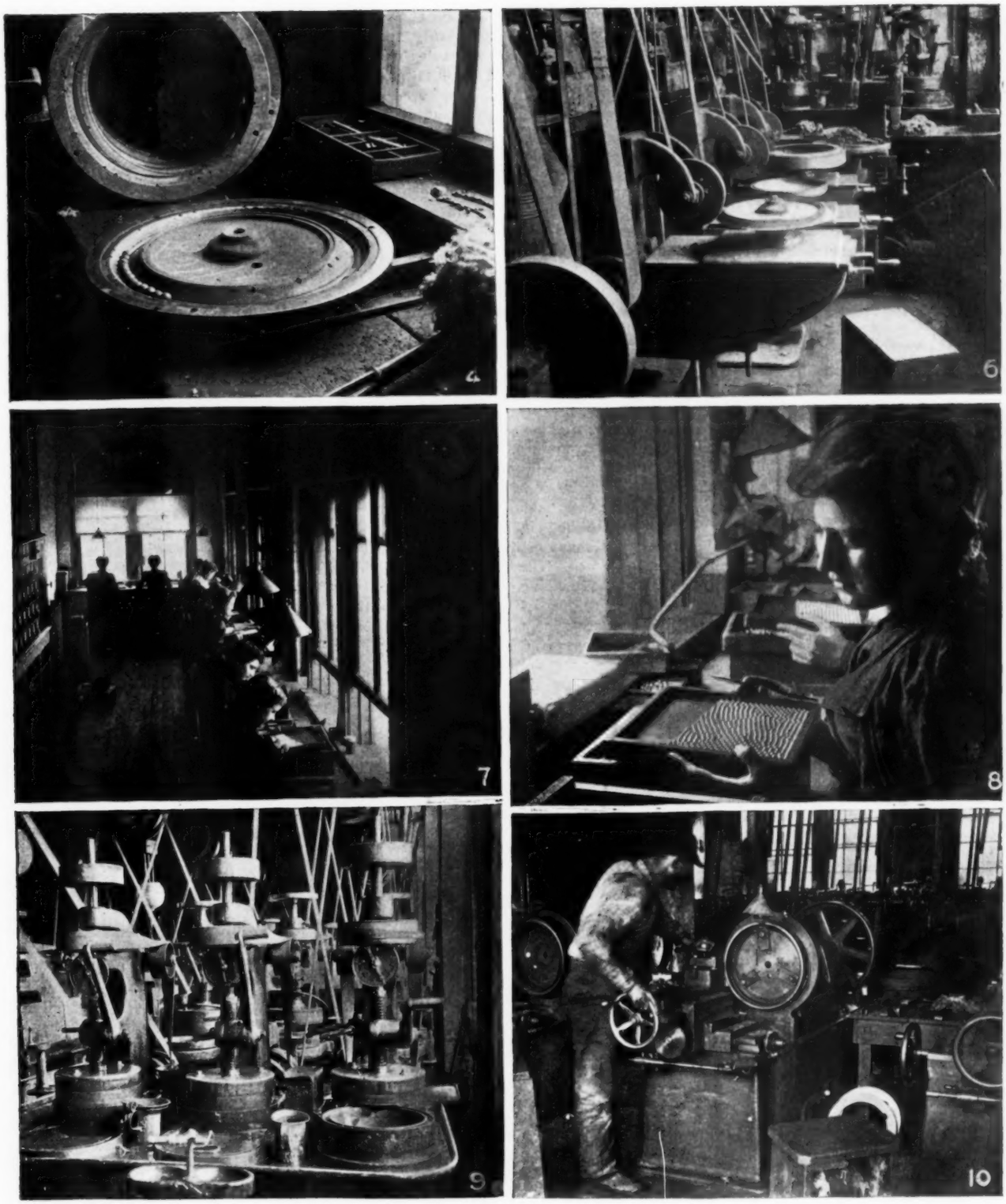


Fig. 5

SKETCH SHOWING PRINCIPAL PARTS OF BALL-GRINDING MACHINE.

The frame is a substantial single casting, having a finished vertical square-edged face, supported by two full-length ribs, rising from a round-cornered flat base plate, all in the usual manner of frame construction. As shown in Fig. 3, the front face of the upright has gibbed to its lower part a head which carries a vertical grinding spindle running in two journals; on top of this spindle is the grinding wheel, shown in section in the sketch, Fig. 5. Between the spindle journals the grinding spindle carries a long, straight driving pulley, driven, as shown, by a belt, passing under idlers at the rear. This lower slide is fitted with an elevating screw operated by the hand wheel *A*, Fig. 3, and rotation of *A* moves the index on the finely graduated dial *B*, which indicates the lift of the grinding wheel in thousandths of an inch. The grinding of a blank to a ball of definite round, and are over the rough-grinding size at which they are to leave this machine. This rough-grinding size is one-thousandth above the finished size; this $+\frac{1}{1000}$ inch being taken off in the polishing machines. The balls used in measuring the diameter are then returned to the V-groove and the grinding wheel elevated to give the proper further reduction of the balls, as indicated on the dial *B*. The grinders, one to each machine, are very expert, and often bring a grooveful of balls to rough-ground size at the first trial; but nothing is left to conjecture. When the wheel is stopped the second time the balls are measured as at first. If right, they are taken out; if not, the wheel is again lifted to a new reading on the dial, and the balls are again ground and again measured. The face of the grinding wheel constantly wears away, and this wheel- which holds the spider *F* normally in its ball-grinding position, shown in Fig. 3. The ball-holding-down ring in the ring-case *E* has itself a ring of holding-down balls on top of it, and spur gear teeth cut on its outer surface, by which it is given a rotatory motion through a hidden pinion and shaft driven by the pulley *J*, also operated by a belt turned under idlers on the rear of the frame braces and carried up to the countershaft. *L* is a stationary knee bolted to lugs on the frame, one of which is shown at *K*, on which a shallow cone-cupped ball catcher *M* can be moved by hand, so as to stand under the ball groove and catch the balls as they drop out of the groove when the spider *F* is depressed; the grinding wheel must, of course, be dropped down out of the way to permit the ball catcher to occupy its place under the ball groove. Only a very



BALL MAKING.

Fig. 4. Grinding Machine Groove Rings. Fig. 6. Grinding Disks. Fig. 7. Ball Inspectors at Work. Fig. 8. Inspecting Rough Ground Balls. Fig. 9. Small Polishing Machines. Fig. 10. Polishing Machine Maintenance.

little part of the ball catcher is shown in the engraving.

The frequent moving up and down of the grinding wheel head makes the dial *B* an absolute necessity; with it the operator can drop the grinding-wheel head and return it to exactly the position desired without the least difficulty. The bottom of the ball catcher is fitted with a horizontally moving slide, and the ball catcher stands over a sliding drawer in the extreme rear end of *L*, so that, when the ball catcher is at the rear end of the ways on which it travels, the balls in the cup can be examined by measuring a few of them, and then all can be dropped into the drawer below by a movement of the cup slide; all of the members of this elaborate train of ball catching, carrying and depositing devices being amply warranted by their efficiency as time-savers.

As shown in Fig. 5, the axis of the guiding V-groove and that of the grinding ring are just the right distance away from each other to make the ring of balls cover the working face of the grinding ring twice in each revolution of the latter. Partly from this feature of independent axes, and partly from the irregular disposition of cutting points in the grinding ring, the balls receive a compound revolving motion, so that every part of the ball surface comes in contact with the wheel, and this makes the balls assume a truly spherical form so long as the working face of the grinding ring is kept perfectly flat; and this flatness is made certain by the traverse of the balls over the grinding surface, also due to the different locations of the grinding ring and grinding ring axes. This peculiar disposition of parts was one of Mr. Grant's happy thoughts; it is a very simple idea, but the embodiment of this idea makes the balls round if the grinding is flat, and also makes the balls keep the grinding ring always flat.

Only a very few of the balls assume the "peg-top" form of a "three-cornered ball." When a ball does assume that form it just simply keeps it. This peculiar solid has a large assortment of uniform diameter measurements, and acts so nearly like a true sphere, when in motion, that no automatic separator has been yet devised that will pick all the three-cornered balls out of a lot of actual spheres, and these monstrosities have to be all selected by visual inspection.

SPECIAL GRINDING MACHINES.

The V-groove of the grinding machines must be very nearly perfect in shape; the slightest wear produces bad work, and several special grinding machines are kept constantly at work repairing the inner disks and outer rings which together make up these grooves. These special grinding machines are shown in Fig. 6. They consist of a frame composed of the usual flat base and box upright with a knee dovetail in front, and a wheel-spindle-carrying stand, having downwardly curved wheel-supporting arms, so that the wheel can make the angle cut on the inside of the outer V-groove ring member, secured to the top of this frame, as shown in Fig. 6. The front dovetail of the upright carries a large vertically adjustable knee, and this knee carries a slide fitted with a vertical automatically revolved spindle, to which the work to be ground is secured. The grinding proceeds automatically, one workman attending the entire bank of machines.

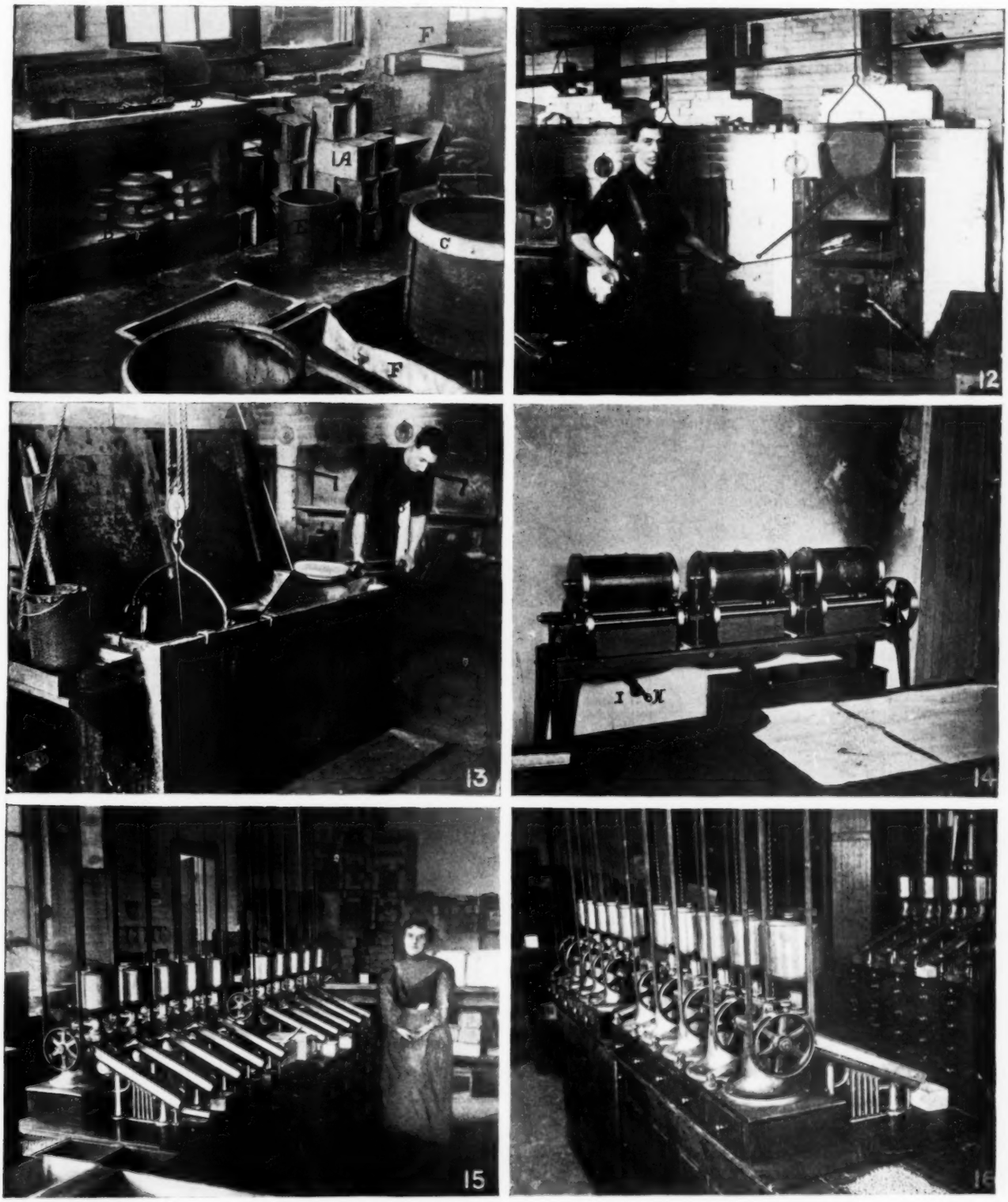
In Fig. 4 a guiding groove disk and ring are shown on parallels on the bench in front of the grinding machines, with a few ball blanks laid in the groove on the left-hand side. A moment's thought will show that all the "necks" and "stems" left on the rough ball blanks will be automatically guided into the bottom opening of the grinding groove by its inclined sides, so that these principal divergences from the spherical form will be first removed from the blank; this makes the machine do, itself, exactly what could only be done much more expensively by hand in the way of trimming off the "necks" or "stems" before the blanks are put in the machine. In point of fact, it makes no difference what shape the blanks are when they go to the grinding machine, so far as the final shape of the rough ground ball is concerned. The high points inevitably go to the grinding wheel first; there is a little space of spark spitting, and then the corners are gone, and the steady dazzling whirl of sparks delivered all round the grinding ring shows that every ball is down to where it touches the grinding wheel constantly.

INSPECTION.

The rough-ground balls go directly to the ball inspectors, a few of whom are shown at their work in Fig. 7. Each inspector uses a shallow tray made of pine and finished with shellac varnish, before an excellent light. All the inspectors are young girls, and the work is very trying. The tray has placed in it balls enough to cover about two-thirds of its bottom, as shown in Fig. 8. The tray is given a twist and tilt to change the position of all the balls and bring them up to touch each other, and then the whole surface of the field of balls is carefully examined. If they are all round there is a ring of reflected light on each one; if a "three-cornered ball lies in a certain position in reference to the direction of the light, the bright line on the ball is not round, but is irregular in form. Each inspector has a magnetized steel point in her right hand, and with this she picks out the flat balls, one by one, as she find them. Not all of the three-cornered balls reveal themselves at the first shake of the tray; time and time again the tray is twisted and tilted, and the dazzling array of polished spheres is scrutinized until at last the inspector is satisfied that she has weeded out every ball not a true sphere. One glance at this shimmering field of balls in the tray is simply maddening to any but the strongest eyes, and such a serious lot of girl-workers are seldom seen elsewhere. This inspection, however, is nice, clean, well-paid work for girls, and all possible aid in the way of careful lighting is given them.

POLISHING MACHINES.

From the inspectors the rough-ground balls go to the polishing machines. These, again, are pillar, base and knee machines, belt-driven, and having their vertical live spindles carried through rack-and-pinion-elevated sleeves, drill-press fashion. The knees have ways on top, on which the lower ball-groove dies slide into two positions—one outside, in which the whole of the ball groove is fully exposed; and one inward position, in which the ball groove is perfectly and exactly concentric with the axis of the vertical spindle which carries the running top grinding ring. The different axis idea of the rough-grinding machines cannot be used in the polishing machines at all. The polishing ring and the polishing groove must be exactly concentric, or the result is the production of three-cornered balls. So exact must this axial correspondence be that it has been found better to give the live spindles a slight degree of play in their boxes, so that they may accommodate themselves perfectly to very slight ring misplacements. The polishing groove die and the polishing ring are both made of gray iron. The polishing groove is something wider than the diameter of the ball to be polished in it, and deeper than it is wide; the top rotating ring is made to fit the groove easily, and the balls are placed in the groove with oil and fine emery, and the top ring and spindle let down on the balls after the lower die has been shoved back into polishing position. In addition to the considerable weight of the spindle and running top ring, the live spindles carry, in the small machines, a considerable disk weight overhead, as shown in Fig. 9, to give holding-down weight enough to secure efficient polishing action. The balls revolve in all directions, and, except a tendency to make very slightly "three-cornered" work, give no trouble whatever. The machines are very dirty and the attendants who are constantly measuring the balls with the stationary micrometers, shown in Fig. 9, have each a tank of benzine in which they wash their hands every few minutes. A skillful industrial chemist gave this benzine matter his attention, and produced a cleansing fluid for use at these machines, almost as good as benzine for the purpose, which could be furnished for $2.50 per gallon, and the benzine continues in use. The dials seen on each of the polishing machines are time dials, with one hand, which is set to a certain number of minutes in advance of the clock, which is in view of all the polishers. The polishing is done entirely by guess. The operator measures a few of the rough-ground balls



MAKING BALLS.

Fig. 11. Hardening Boxes, Saggers and Sieves. Fig. 12. Heating Balls Ready to Harden. Fig. 13. Hardening Balls. Fig. 14. Ball Tumblers. Fig. 15. Front of Bank of Ball Gaging Machines. Fig. 16. Bank of Ball Gaging Machines, Rear.

and guesses that it will take the machine 2 or 3 or 4 minutes, as the case may be, to polish the rough over-size ball down to its finished size. He starts the machine at its work, and sets the dial to the clock minute at which the machine is to be stopped. When the clock time comes, the operator stops the machine, pulls the grooved die out, scoops out a few balls with a scoop made to fit the groove, washes them in benzine, and measures them with the micrometer. He then either scoops the lot out into the benzine tank of finished work or puts the measured balls back into the groove for another whirl in the machine, as the measurement demands. As is the case with the rough-grinding machine hands, the polishing machine tenders acquire great expertness in estimating the time performance of their operations, and make wonderfully close guesses as to the minutes it will take their machines to make the required ball diameter reductions by the fine grinding termed "polishing."

The polishing rings have to be kept in perfect form, and three special polishing-ring turning machines, shown in Fig. 10, are kept constantly at work on them. These machines are a very rigid tool, from special designs by Mr. Grant, having massive beds to prevent vibration, extremely heavy tool slides, and especially designed rigid tool-holders; the tool slides have automatic feeds in both directions, and this tool is in many particulars a very advanced production, and shows what experience has dictated in the way of needful departures from ordinary lathe practice for such work. This special lathe we consider quite well worthy of more than a passing glance from the tool designer. It will be noticed that the V-slide ways and the angular dovetail are conspicuous in this design by their absence; the dovetails are all square surface ways with liberal dimensions.

HARDENING.

From the grinding machines the balls go to the hardening room. The small tools in the hardening room are shown in Fig. 11. There is the usual substantial zinc-covered table *D* for packing work which is to be case-hardened in "saggars" or cast-iron heating boxes, a pile of which is shown at *A;* wire cloth sieves and buckles of various forms for catching work dumped into hardening baths, one of which is shown at *C;* wooden boxes of various dimensions; sheet metal trays *F, F;* metal cans *E,* and all the usual outfit of the hardening room. In addition to these there are the very peculiar shaped boxes in which the balls are heated for hardening. A pile of these boxes is shown at *B,* and one of them is shown in Fig. 12 in the furnace, and the same one appears in Fig. 13, where its contents are being dumped into the oil hardening bath by the workman. This ball-heating box is made of gray iron, and is somewhat similar in form to a Scotch "Tam-o'Shanter" cap, having a lug cast on one side to be grasped by the tongs when the box is taken from the furnace. The form of this peculiar heating box is pretty well shown in Fig. 11 at *B,* and in Fig. 13; it has a small mouth, and a large, round base, the top being drawn in so as to radiate the heat down on top of the balls which cover the bottom of the box. The heating furnace details are pretty well shown in Fig. 12; the fuel is coke. The exterior of the furnace contains a long gray-iron slab reaching from front to rear of the brick arch, but not so wide as the furnace, and so placed as to leave a long, narrow flue on each side the whole length of the oven. This slab is over the fire, and is kept at a medium red heat, about the same as that to which the balls are heated. Only a few balls are put into the heating boxes at a time, the box being red hot when the balls are put in; then the box is put on the slab in the furnace, a long poker with a bent end, to enter the mouth of the heating box, being used to locate and turn the box as is required to heat it evenly. The workman uses two furnaces, and keeps three or four or five heating boxes in each furnace all the time. Considerable care is used in placing and moving the boxes in the furnaces, and the reverted tops of the heating boxes make the heating of the balls almost exactly uniform, so that in no case was there any difference in the color of the balls to be observed when they were dumped into the oil tank.

The oil tank, Fig. 13, is of metal, provided with a hinged cover to keep out dust when not in use, and has a metal incline at the workman's end, hooked over the tank end, and leading down under the oil to the top of a submerged wire cloth bucket suspended by its bail hooked to a rope fall, as shown clearly in Fig. 13, all arranged so that the balls, when dumped out of the heating boxes, fall through five or six inches of oil before striking the metal incline which guides them into the wire cloth bucket, wherein they fall nearly to the bottom of the tank to cool. Very few balls, comparatively, are handled at one time, and where they are of small size a considerable value goes in a small bulk—3,000,000 balls, worth $5,000 or $6,000 finished, only filled a pretty big barrel about half full, and all through the ball-making operations the observer is constantly surprised at the small bulk of balls under treatment.

The writer did not see the larger sizes of balls in process of manufacture; the pictures are all taken from operations on balls ½ inch diameter and under. Balls about inch or inch and a quarter diameter were seen in the large rough-grinding machines, but they were in a bad light for photographing; these large machines made a very brilliant spectacle at work, like a firework Catharine wheel, but a snap-shot of the camera failed to produce any representation of the large, swift disks of scintillations which were so brilliantly impressive to the eye. A lot of beautiful balls, made for pump valves, about 3 inches in diameter, and also balls as much as four or five inches diameter, were seen, but they were not being made in such numbers as to be followed through all processes of their manufacture, and therefore were not photographed.

TUMBLING.

From the hardening room the balls go to the inspecting floor, and are first put through the tumblers, one bank of which, containing three barrels, is shown in Fig. 14. These are very neat, polished oak barrels, having the staves fitted into polished gray-iron heads, and the doors and door fastenings in the sides of the barrels made of polished flat stock. Each barrel rests on four friction driving rolls, all the driving rolls being carried on two parallel driven shafts, each mounted in four journals; the rolls are close up to these driving shaft journals, which run in boxes in elevated pedestals high enough above the iron top plate of the frame to permit wooden catch boxes to slide under the barrels. When the barrels are at work they rest on the friction rolls; gudgeons in the barrel heads are confined sidewise in open slots cut in the ends of double-ended vertically sliding forks, pivoted at their lower ends to hand levers *H.* These slot-ended forks are guided vertically, and can be lifted up by the hand levers, carrying the barrel bodily upward off the friction rolls, and the levers can be latched into hooked keepers *I* so as to hold the barrels up as long as desired. When the barrel is to run, the lever *H* is unhooked and the barrel dropped to rest on the rolls, which run continually. The iron bed plate stands on iron legs, and this whole rig is one of the neatest tumbling-barrel arrangements we have ever seen.

The balls are here tumbled until perfectly burnished by their action on each other, and then go back once more to the inspectors, brighter and more trying to the eyes than ever before, and with only very minute variations from perfect roundness to be detected.

FINAL INSPECTION.

The final inspectors first put the balls into a canton flannel bag, and holding the bag horizontally, one end in each hand, pass the balls from one end of the bag to the other until they are perfectly cleaned, and then begin the tedious process of inspection once more. Each tray of balls is shifted and rearranged and turned different sides to the light time and time again, and scrutinized with incredible care and patience, so that very few flat balls indeed are finally passed as round. The rough-ground ball inspection is mere

child's play compared with this finished work inspection; in the first place, if a rough-ground ball is not perfectly round, it is commonly "three-cornered" to a readily observable extent; and again, the surface is cut in so many different lines that it is not so painfully brilliant as the finished ball. The variations of the finished balls from true sphericity are very small indeed, but they may be very rare or very frequent. If there is the slightest fault in the polishing ring surfaces, or if there is the slightest eccentricity of movement of the top ring of the polishing machines, then a large percentage, or even a majority of the polished balls which went as true rough-ground balls to the polishing machine, may be polished flat; sometimes when a polishing machine seems in perfect order it will turn out flat work, and nothing short of the care of the final inspectors can save the reputation of the manufacturer. As before stated, the nameless solid known as a "flat" ball, or a "three-cornered" ball, has so many different diameters of uniform length that it can and will mimic the movements of a sphere under almost all conceivable conditions of test, so that while the hand-applied micrometer will readily detect its flatness, no automatic sorting machine has yet been devised which will certainly throw out all the flat balls in a lot of work put through it.

GAGING AND SORTING.

Although the balls made by the processes described have been carefully watched and measured at each stage of production, they are by no means the same size when finished, though the limit of variation may be quite small. The machines for sorting the balls into different sizes have five delivery tubes, and sort the balls into as many diameter variations. It is not remembered how these variations are divided; but probably the middle tube is standard. Say for quarter-inch balls the middle tube is expected to deliver balls measuring 0.250 inch; then (See Fig. 15) the first delivery tube at the left would deliver balls 0.249 inch diameter, the next 0.2495 inch, the middle one (as assumed) 0.250 inch, the fourth one 0.2505 inch, and the fifth about 0.251 inch, and all balls larger than 0.251 inch would run off the divergent gaging ways at the end, fall into the "over-size" box, and be sent back to the polishing machine for reduction.

The sorting or gaging machines in use at the Cleveland Machine Screw Works are composed, essentially, of two hardened and ground steel ways, closer together at the top than at the bottom end, and set at an angle of inclination of about 30 degrees. The balls are fed on the ways at the top end, one ball at a time. The balls start at the top, where the ways are much too close together to let them drop through between the ways, at quite a rapid rate of travel; as they go down they go slower and slower as they fall in between the way edges lower and lower, until they are almost at rest before they drop through the divergent ways at a point which indicates, approximately, the actual ball diameter. The balls will always stop if one overtakes another near the dropping-through point, and the attendant has a metal "separator," shaped like a paper-cutter, with which she parts them.

The Grant automatic ball-gaging machines are shown in two views of two banks of five machines each; there were ten of these machines in use the whole twenty-four hours of the day, and besides these there were an equal number in process of construction; a number of hand-fed machines being also used.

The machines are very simple; from the round ball hopper on top the balls are dropped, by a simple eccentric and bell crank actuated gate in the bottom neck of the hopper, one at a time, on the inclined ways, and they drop through the ways into one of the five tubes shown. A sixth curved spout, above the five straight perpendicular spouts, catches the under-size balls, and the over-size ones go into the boxes at the lower end of the ways. One girl easily attends this double bank of twenty machines, which are quite slow in action because of the great retardation in the speed of the balls as they approach the dropping-through point; since the balls stop descending the ways if one ball overtakes another in its downward travel, the dropping machine between the hopper and the ways is arranged to give what seems like a long time between successive ball deliveries from the hopper to the gaging incline, and like every other step in ball manufacture, except the work of the screw machines which cut the rough balls from the tool-steel rods, the action of the gaging machines seems slow and the output small for the excellent production means employed.

The counting of the balls is done in shallow wooden trays of two kinds. For the smaller sizes of balls, Fig. 17, the bottom of the counting tray is honeycombed with depressions which will hold a ball with its top flush with the top surface of the bottom; more than balls enough to fill the despressions are cast into the box at random, and a single twist and shake of the tray in the hands of the counter and boxer fills the depressions; the surplus balls are poured off by a slight inclination of the tray, and then a greater inclination empties the depressions. For the larger balls, as shown in Fig. 18, the bottom of the tray is cut into troughs lengthwise, and these troughs are interrupted by filling pieces, so as to make the balls stand in columns as shown in the engraving, where the balls stand in four columns of forty balls each, four balls in a line and ten lines in a column. This is a rather odd multiple of 160 balls for the count, but the weight of the large balls is very considerable, and the size of tray is made such as to give a weight easily handled by the girl who does the counting and boxing.

Fig. 18. COUNTING BALLS. Fig. 19.

A careful study of the Cleveland Machine Screw Company's ball-making plant shows plenty of reasons for the fewness of the ball-making establishments in the world. There are only three makers of such balls in the United States; of these three, two were originated by Mr. Grant, and both employ methods and machines devised by him. Although at this writing there is such a demand for cycle-bearing balls that customers are treated as suppliants by the manufacturers, there is no inducement to go into ball-making without machinery in sight which is at least equal to this, and capital enough to fight a long, hard battle for the market, which can hardly be expected to forever buy anything that looks like a ball at the manufacturer's own prices.

Balls are used for a great many machines besides bicycles. The Cleveland Company carry an enormous supply of both rough and finished stock; it is the intention to keep balls up to 2½ inches diameter always in stock, and the rough stock of tool-steel rod must be sufficiently large to fill a large special order for balls of any size without having to wait to send to the steel mill for material. One entire large floor of the factory is filled with

rackfuls of rods of all sizes, from those for making ball blanks for ⅛-inch balls up to the 2½-inch size; it is a very large lot of tool steel, and a view of it is very impressive.

The Cleveland Company do not believe a ball should be extremely hard. Balls fail in cycle bearings in two ways; by splitting, and by wearing flat. If a ball stops rolling in a bearing it at once has a flat spot formed on it, which makes it forever useless, and balls often split in two when at work. Just how a solid, sound steel ball can be split in such light company as the parts of a cycle bearing is difficult to understand. Nevertheless, the bearing balls do split, as is well known.

As the Cleveland balls are cut or forged from the solid rod, the blank is never "piped" or fissured before it comes to the grinding machine, and there is no possibility of stress on the ball in any of the finishing operations. Though there is always danger of hardening-cracks in any tempering operation, by careful heating in the manner described, only a few balls in a heating box at a time, and quenching in oil, the probability of hardening-cracks is reduced to a very low expectation.

Hardening in oil does not give the hardness or brittleness which come from quenching in water, and the Cleveland balls can be scratched with a file; they are much tougher than a harder ball, and it is claimed that this toughness is much better for wearing endurance than an extremely hard surface.

It is quite evident that there must be a very large consumption of ball-bearing balls outside of the cycle trade; one of the sewing machines now puts its most important rotatory member on a ball-bearing and the Lozier Cycle Factory grinding machines have both the work-carrying and the grinding-wheel spindles mounted in ball-bearings. It seems quite possible in view of a production of 16,000,000 balls per month by a single firm, that the use of the ball-bearing is being rapidly extended.

One complete ball-making plant has been supplied by the Cleveland Company to Clement, of Paris; otherwise the method of making balls here described is unique, and for obvious reasons it will long remain the only one of its kind in the United States.

ELECTRICAL MACHINERY.

An Improvement in the Manufacture of Lead-Coated Wire for Underground Cables.

BY FREDERIC R. HONEY.

My attention has been called to a recent invention by Mr. E. H. Johnson, of Seymour, Conn., of an improved construction of lead press, designed to manufacture with great rapidity and precision, as well as at a low cost, lead-coated electric conducting wire used for underground cables. The principal object of the invention is to furnish a sleeve adapted to guide the charge of lead into the die chamber at diametrically opposite points, thus relieving the core die of all side strains. When the charge is admitted at only one point the enormous pressure is liable to bend the core die, causing great delays and unsatisfactory work.

Another feature is an easily adjusted and simple core die, and in connection with it a tube die, easily removed and replaced, and adjustable in relation to the core die.

The hydraulic cylinder *a*, Fig. 1, carries four supporting columns which sustain at their upper ends the head *b*, from which hangs the stationary ram *c*. The hydraulic piston *d* has resting upon it the die block *e*, which supports the supply chamber *f*. The supply cylinder is fitted with a steam jacket in order to maintain the cylinder at a high temperature. The supply chamber being charged with lead, the admission of pressure water to the hydraulic cylinder *a* forces the lead through the opening *h* into two grooves on a sleeve *i* surrounding the core die *j*, of which grooves one is shown at *k*, while both may be seen in the end view of the sleeve, Fig. 2.

It will be seen (Fig. 2) that these grooves, beginning at the top of the sleeve *i*, diverge downwards and around the sleeve, and terminate in two diametrically opposite openings, whereby all side strains upon the core die are eliminated. The sleeve *i*, which is hollow and receives the core die *j*, is screwed into the die block. The core die is likewise held in position by the threaded portion at the outer end, and is provided with a central

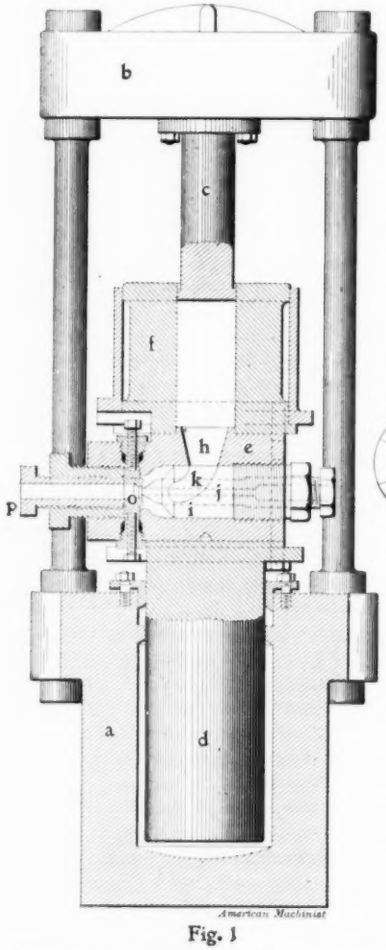


Fig. 1

PRESS FOR MAKING LEAD-COVERED ELECTRIC CABLES.

opening of proper size to pass the wire or cable.

The tube die *o*, which has a central opening of the desired shape of the lead tube, is mounted in a ring which is held in its central position by set screws. The tube die is readily centralized with the core die by means of these set screws, and is clamped in its position by the hollow set screw *p*, and can be readily removed and replaced when worn or broken.

In Figs. 3 and 4 end and side views of the sleeve are shown, in which each groove separates into two branches, thus forming four passages for the metal.

Fig. 2

Fig. 3

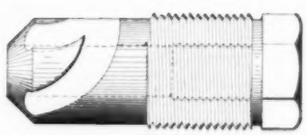


Fig. 4

Shunt-Wound Reversing Motor, and the Switch and Wiring Connections Used Therewith.

BY WM. BAXTER, JR.

The reversing switch used in connection with shunt-wound motors is very similar to that used with the series machines, a description of which was given in a former article; but owing to the fact that the current passes through two circuits in the shunt motor, certain changes have to be made in the shape of the cylinder plates, and also in the wire connections. These changes will be explained in the following paragraphs, by the aid of the accompanying diagram:

The switch, as was explained in the article referred to, consists of a cylinder upon the surface of which there are plates

of the shape shown by the shaded outlines *D, H, J, K, S* and a row of stationary contacts, which in the diagram are located between the two sets of cylinder plates. In the series switch there are three plates on the side of the cylinder used for the forward motion, and five on the side used for the reverse; but in the shunt switch only two plates are required for the forward side, and three for the reverse. The reason for this will be made obvious by the explanation:

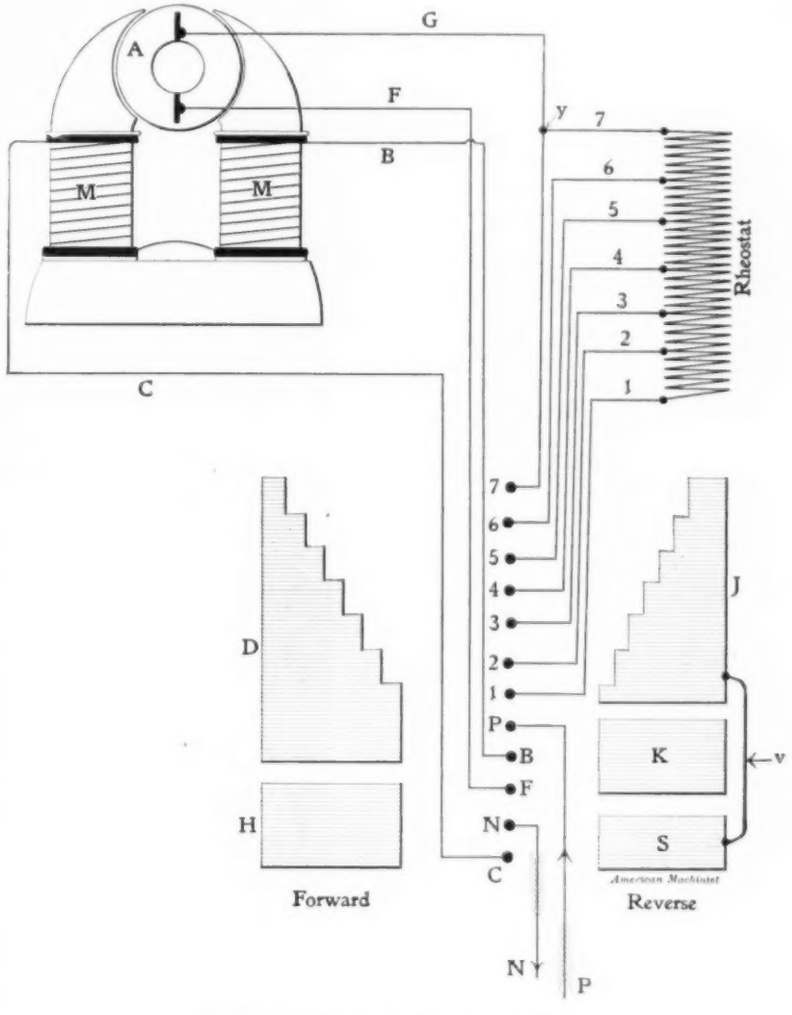
If the switch handle is turned so as to run the motor in the forward direction, the current coming through the wire *P* will be diverted into wire 1 and *B*, since, when the switch handle is turned to the first point, the plate *D* will connect the three contacts 1, *P*, *B*. The current that passes into *B* goes to the shunt field magnet coils, and returns to the switch by the wire *C*, just the same as in the series motor. The current that passes into the wire 1 goes through the rheostat, and, by wire 7, passes to wire *G*, which it meets at the junction *y*. Through *G*, the current reaches the upper brush and passes through the armature to the lower brush and the wire *F*, and thence to contact *F* of the switch. From this it will be seen that the current in *P* divides as soon as it enters the switch, and goes through the field magnet coils and the armature at the same time, and that the two currents on their return to the switch meet, and are connected with *N* at the bottom by the cylinder plate *H*, which covers the three. In the series motor the current from *P* enters the magnet coils first, and, on its return through the wire C, passes by the connection, made at the switch, to wire *F*, and thus through the armature, after having passed through the field; but in the shunt arrangement, the current that passes through the field goes direct to wire *N*, while the current that traverses the armature does not pass through the field first, but comes straight from *P*.

The operation in passing from point to point is the same as with the series motor; that is, at each successive step a portion of the resistance is cut out. On the second step, contact 2 is covered by the plate *D;* on the third point, contact 3 is covered, and so on to the 7th point, where all the contacts are covered and all the resistance is cut out.

When the switch handle is turned to the reverse motion side, the effect is to reverse the order in which the wires *P* and *N* connect with the armature terminals. Tracing this out on the diagram, it will be seen that the wire *P*, instead of being connected with 1 and *B*, as was the case on the forward motion, is connected with *B* and *F* by the plate *K*. It will also be seen that wire *N* connects with 1 and *C*, owing to the fact that the plate *S* is connected with plate *J* by the wire *U*.

This diagram shows what the connections are when the motor is of the simple shunt type, which is the kind most generally used; but the same switch can be used in connection with a differentially wound motor. The only difference between these two types of motors is that in one the field is magnetized wholly by the action of shunt coils, but in the other, in addition to these coils, there are series coils through which the whole current passes. In order to make this switch act properly with a differentially wound motor, it is necessary that it be so connected that the current through the series coil may not be disturbed, for the simple reason that the current in the shunt coils is not disturbed. To accomplish this, all that is required is, that either one of the wires *P* or *N* be connected with one end of the series coils, the other end of the coils to be connected with the same contact in the switch that the wire would run to if there were no such coils. If this connection is made, the current in the series and shunt coils will always be in the same direction.

A careful examination of the diagram will show that the current from the wire *P* always enters the field coils through the wire *B*, no matter whether the switch is moved to the forward or the reverse motion; this being the case, if follows that if the current in the *P* wire, say, passes through the series coils first and then goes to the contact *P*, the current in the latter will always be in the same direction, and will not be affected by the movement of the switch. The only change effected by the switch in passing from the forward to the reverse position is to reverse the current through the armature. This can be easily seen, for the plates on the forward side connect *P* with 1, and this latter contact leads to *G* and the upper terminal of the armature. The plates on the reverse side connect *P* with *F*, which leads to the lower terminal of the armature.



SHUNT MOTOR AND REVERSING SWITCH.

▲ ▲ ▲

Letters from Practical Men.

Deep Wells and Carbonic Acid Gas.

Editor American Machinist:

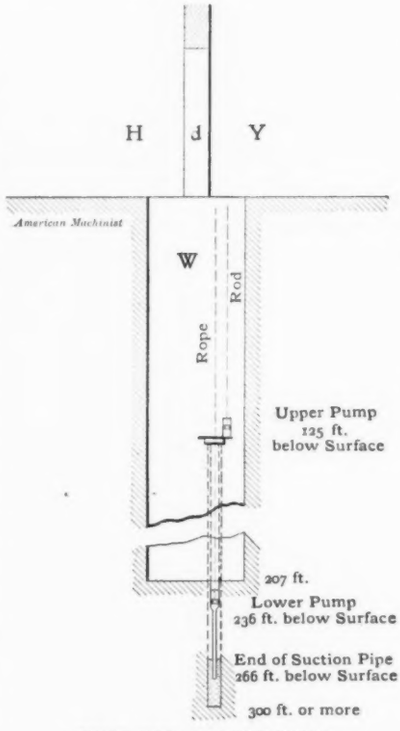
I wrote some time ago upon the question of foul air and the influence of the variations in the atmospheric pressure upon the gases in coal mines. I did this under the incitement of a statement in some paper that the question of colliery

explosions had very little to do with the barometric pressure, or, rather, that explosions were not more probable in bad weather—*i. e.*, with a low barometer. Should such an idea be allowed to pass it would, I feel certain, be productive of harm. At least such is the outcome of reasoning applied to my own experience, even though this is not much connected with mining.

The annexed sketch will help to illustrate what I mean, and it has been so particularly instructive to me that I am tempted to make it common property in hopes it may perhaps even save an accident.

W is a well, dug to a depth of 207 feet, and it has a diameter of 4 feet. When my connection with it began I found that the operation of digging had become very costly, because it was necessary to keep two hand blowers at work to make the well fit to work in, and, even with the blowers, work was not always possible. The position of the well is peculiar, one-half exposed to the open sky in the yard *Y* of the building, and half being inside the house, *H* being a small room or kitchen. As the digging of a well is a pastime handed down from remote ages, we may take it that the choice of such a position possibly has the sanction of precedent, and so I will confine my remarks to observed facts rather than to comments on the mental attitude leading to such a choice, when the area of the outer space *Y* was practically unlimited. Now, this well is positively the very worst case it has ever been my lot to encounter, for it was at times so productive of carbonic acid gas that although the doorway *d* was always free, and there was no door there during the progress of work, there were times when a candle would not burn a yard or more above the floor in the room *H*. My own procedure, the well being dry at 207 feet, was to bore deeper until sufficient water was obtained, and to put in pumps extending in two stages to a total depth of 266 feet, and, by working with a two-throw crank and driving the lower pump by means of a steel rope 120 feet long, and then rods below this, obtaining an almost exact balance of duty on the cranks, both in weight of metal and of water. The bore pipe coming up to about 125 feet from the surface, all my work could be done at or above this point. As a matter of precaution, it was necessary to hang candles both above and below the 125-foot working point, and to tell off a man whose sole duty was to keep an eye on the candles and at once haul up the pump fitter if they went out, while the fitter himself was lashed fast to the seat and rope and the india-rubber blower pipe arranged to blow directly upon his face. Notwithstanding all the precautions it was often impossible to go down the well; yet on some days not a single precaution was needed, though maintained.

I was able to know in London the days when work was progressing or standing still fifty miles away, simply by noting the barometer, and all through the work—covering some weeks with delays—it was invariably the case that the state of the well corresponded with the atmospheric pressure. It is not the top and bottom positions of the mercury that are times of best and worst conditions in a foul well. It is when the barometer is rising and falling that such conditions obtain, and possibly after long periods of steadiness. Suppose that for some time



PUMP FOR A DEEP WELL.

the mercury has stood at 30½, and drops steadily to 29½, then the earth must give out somewhere about 3 per cent. of its contained gases, and the greatest quantity will obviously escape at wells which cut through the fissures of the rocks in which gases are occluded; and, similarly, when the barometer rises from 29½ to 30½, about 3 per cent. of air must rush in to fill the space at the higher pressure. A well forms a good easy inlet, and fresh air simply pours into it, pushing the foul air back into the rocks and keeping the well fresh and good so long as the rise continues, and easily ventilated until the pressure again turns, and then the flow of bad gas very quickly occurs and it needs careful watching to guard against it.

There was, of course, a special reason for this particular well being so bad. The rock in which it was dug is a sandy rock belonging to a geological formation peculiar to England, and to the southeast corner of the country, and the particular stratum is peculiar, in that it contains great numbers of veins of coal, only perhaps an eight or a quarter of an inch thick, and even less, but coal all the same, though the rock is not one of the so-called carboniferous series. These veins of coal are the explanation to me of the large volume of carbonic acid gas, the constant breathing of the earth finding the supply of oxygen to form carbonic acid with the carbon. In the present case possibly the carbon was in a condition to be readily oxidized, and the rock was of a very porous nature, letting in large volumes of air; hence the trouble, which was so persistent and so marked and productive of a good deal of expense, and therefore specially noticeable.

This is but one of a series of general observations that I have made for some years past on the influence of barometric pressure; but being of so special a nature and so unmistakable, it seems worth special notice. As regards the method of working the pump by a wire rope, I do not think this is original; but it is very convenient as a means of finding the balance of two pumps at different depths, the weight of a rope being easily very much less than the weight of solid rods and couplings, and also much easier fixed in difficult places, especially where there is any sort of a corner to get around. Before applying, the rope ought to be well strained to kill its elasticity.

W. H. Booth.

London Eng.

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Tacks and Tack Dies.

Editor American Machinist:

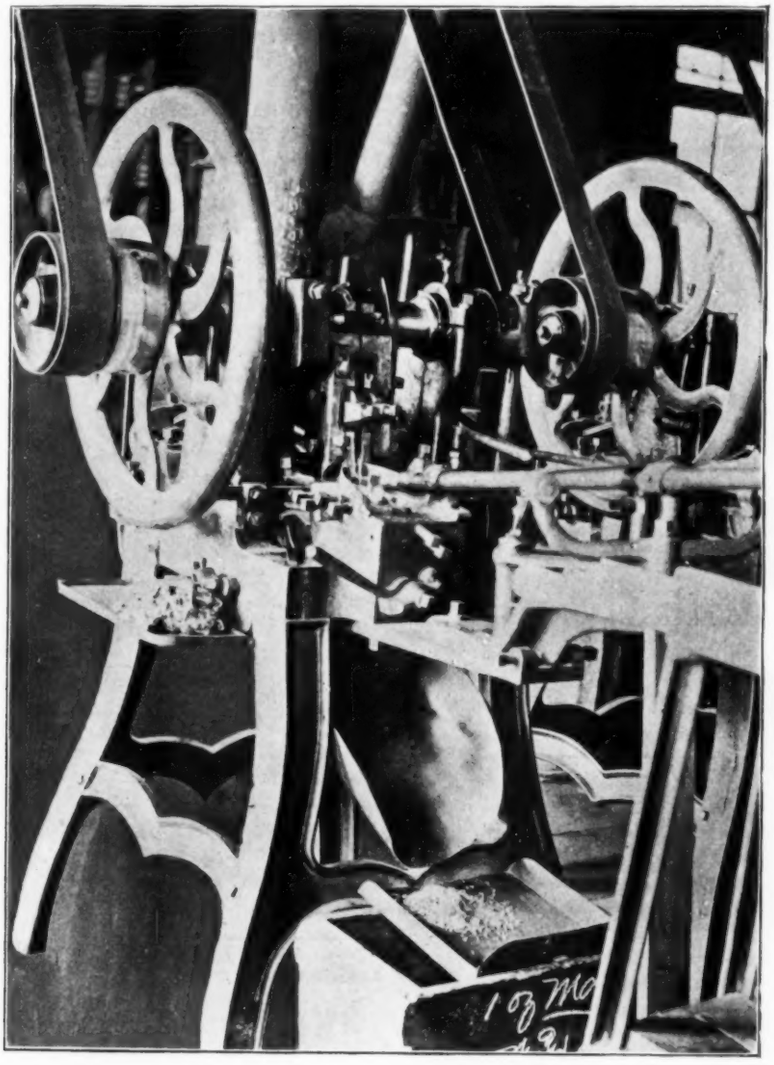
We all know what tacks are, at least those of us who are married. We have bought them, driven them, pulled them out, stepped on them, and have had our tires punctured by them; but although we know them so well, a few points on the history of tacks, and on the machinery used in making them, may interest some of your readers.

Although produced by what look to be the crudest of dies, and which are made and kept in order by the use of the grindstone or emery wheel alone, the manufacture of tacks is attended with the least waste of material, and the smallest percentage of bad work, of any business in the sheet-metal line that I know of.

Some years ago I was interested, both mechanically and financially, in the making of both tacks and tack machinery (the financial part was, I had to work harder to get my wages than I did to make the tacks), and while thus engaged I accumulated a lot of information on the subject that may interest some of your readers.

Tacks were first (I was going to say invented, but I hardly think I could back that claim up) made in the seventeenth century, and in 1775 one Jeremiah Wilkinson of Cumberland, R. I., started the manufacture of tacks cut from sheet iron

with hand shears and headed with a hand hammer in a bench vise. In 1786, Ezekiel Reed, of Bridgewater, Mass., invented a machine that would partially make a tack, and in 1798 he took out a patent on a machine for cutting off and heading them in one operation. This machine was fed by hand; but with that exception it was practically the same as the Reed nail machine in use to-day. In 1827, Thomas Blanchard, of Abington, Mass., invented a machine intended especially for tacks. This machine is what is known to this day as the Blanchard tack machine, and is the only successful machine in use for cutting tacks from sheet metal that I am acquainted with. As first made, it was a hand-fed machine, whereas now it is automatic; but with that exception the machine was precisely the same as built to-day. The tack is cut off by the contact of the two upper knives and the bed knife below. In the action of cutting, the two upper knives work as one; and as soon as the blank for the tack is cut off, the left-hand knife, known as the "loggy," stops, and the right-hand one, called the "leader," holding the blank by the aid of a bent finger of steel called the "carrier," carries it down into the gripping dies, which close and hold it while the heading tool comes up, upsetting the stock which has been left projecting out from the dies for the head; and, as the dies open, a knock-out attachment clears the tack from them, and it falls into the pan below. These operations, five in number on each tack, are performed at the rate of 275 tacks per minute, and for nearly 600 minutes in a day. One tacker and a good boy will grind, keep the dies in order, and operate eight to twelve machines.



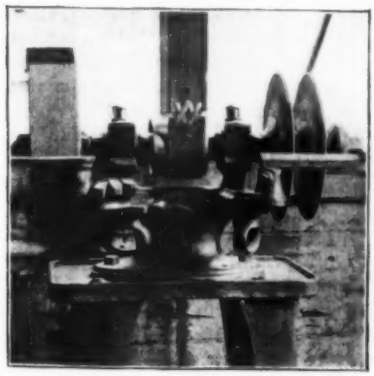
TACK MACHINE.

The die-making outfit shown in the second cut consists of a single machine, a double-ended emery grinder—one end carrying a large, coarse wheel for roughing out the dies, and on the other, two or more thin wheels for "scoring in" the gripping dies and making the countersink seen under the head of the tack. Very little forging is done on the dies. The heading die is drawn down to about ⅜ inch square so that it will not strike the "leader" knife, and the "loggy" is drawn down thin so as to avoid the gripping dies.

I have made an attempt to show these dies on the rest at the left of the emery grinder, but have only partially succeeded. I am having my first experience with a camera, and it makes me think of a good lawyer—it may tell the truth, the whole truth, and nothing but the truth; but it does distort it fearfully.

There is one thing about the machine I think is remarkable, and that is, the test of time the invention has stood; it has been in use nearly seventy years, with little or no improvement, except on the feed motion. As originally made, it could be built with very few tools, no planer work being necessary and very little lathe work, the shaft being of cast iron with the cams cast on; and I never listen to the music of their running (for it is music to me) without a feeling of admiration for the man who invented the machine so far in advance of the age in which he lived.

J. L. LUCAS.



TOOL-ROOM OUTFIT!

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Fire Protection.

Editor American Machinist:

In all fire underwriters' rules there is one calling for heavy mill construction, which means that the floors shall be heavy plank with finished flooring, making four or five inches thick; and nearly the same for the roof. This is the general plan; the object being to create something that will burn slow enough so that it can be found out, and put out, the idea being that the more bulk the slower it will burn.

After a building of this description has been up a few years—long enough to become thoroughly seasoned and covered with dust—let a fire get a good start, and no ordinary fire company will put it out. Take a building one story, iron floor, trussed roof covered with heavy plank and slate—if such a roof gets a start, it will not be put out.

The more thoroughly seasoned timber there is in a fire, the hotter that fire will

be, the stronger the draft to fan the flames, and a 1⅛-inch stream of water will not reach the timber at all, but will be dissipated in the flames. The only thing that can be claimed for this construction, and probably all that is claimed, is that it will start slowly.

When we consider that in most mills the watchmen only get around once an hour, there are great possibilities. In some mills, the first trip the watchman makes he opens all doors between rooms and into stair towers, so that he can rush through the rest of the night quickly and easily. If a fire gets started in a concern like that, destruction is sure, whether it be light or heavy construction; and also, if equipped with sprinklers, it is a pretty sure loss.

There is a question if it is not better to dispense with watchmen and equip buildings with sprinklers and thermostats, having one man at some central point who could give the alarm. A case in point is a large concern that had its carpenter shop equipped with thermostats and connected with a central office. As good fortune would have it, a boy was in the mill office; he got the message and went out to the watchmen and told them there was a fire in the carpenter shop. They said it was impossible, as they had just come from there, but finally started out to investigate and found the fire company at the gate clamoring to come in to put out the fire in the carpenter shop—and sure enough, one end was all in flames. If safety had depended on the watchmen, and they not getting around again for an hour, there would have been a chance for a big fire.

There is one mill that has a good system of watching. The property is divided into two sections. From each end of each section a watchman starts once in half an hour, must get back in, and at the same time be the half hour in making the trip. It is evident that these men must pass one another once in fifteen minutes. These men do not make any record of their movements, but give their whole attention to watching. There is one man whose movements are recorded, and he covers the entire distance in one hour and looks after the four men and sees that they are attending to duty. With such watching a fire must be discovered before it has gained much headway. Even here human fallibility comes in, and in the short space allotted them they have been found asleep.

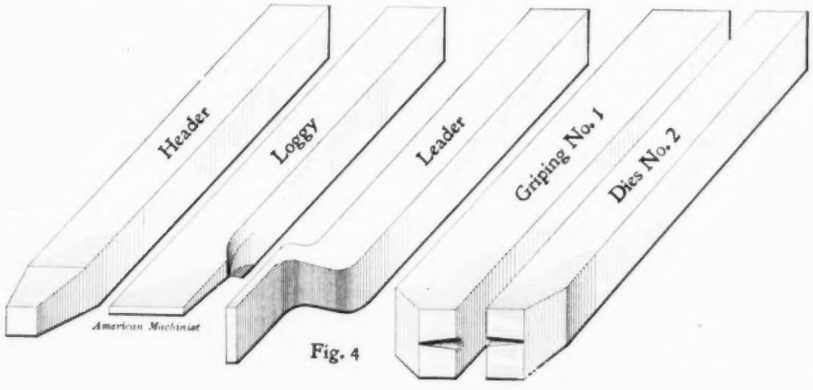

Fig. 4

A SET OF TACK DIES.

A regular fire pump has an inside plunger and a great amount of clearance. As a consequence the pump is under constant motion, as an inside plunger will never be tight. This makes a large expense for coal. There is one manufacturer who claims that no coal is consumed that is appreciable, but you can't exhaust steam from a pair of 18 inch cylinders making from five to ten strokes per minute without taking coal—the point being, how much?

The more clearance there is, and the more leak there is, the less efficient the pump will be up to the point of a sufficient passage through the valves, and the valves should be of large area rather than a high lift. The larger the clearance and the more leaks there are, the longer it takes to exhaust the air and get the water to flowing. Were it not for the extra irregular strain on the hose, a single pump would be preferable to a duplex, as it is so much surer.

W. E. CRANE.

Waterbury, Conn.

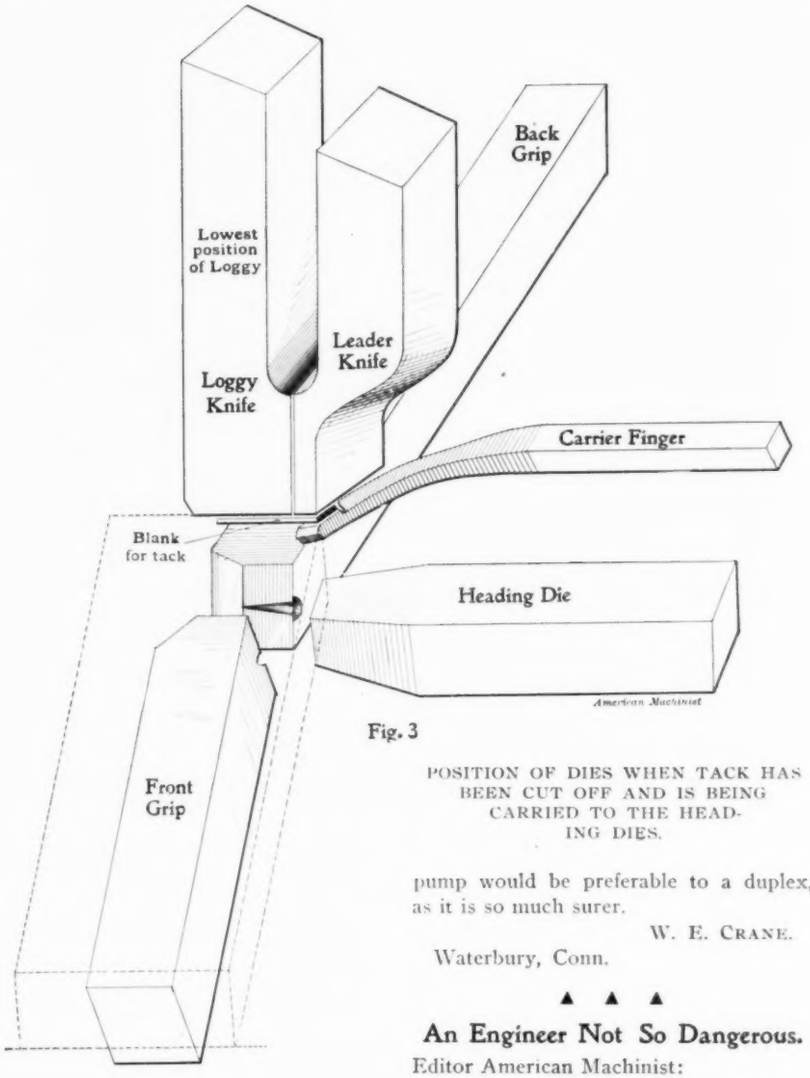

Fig. 3

POSITION OF DIES WHEN TACK HAS BEEN CUT OFF AND IS BEING CARRIED TO THE HEADING DIES.

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An Engineer Not So Dangerous.

Editor American Machinist:

Reading your editorial on "A Dangerous Engineer" reminds me of one whom I met in this city several weeks ago. Happening into a refrigerating plant, and wishing to add as much as possible to my somewhat limited store of knowledge, I

entered into conversation with the engineer (?). He told me that his engine was too small; that it required 300 pounds of steam to run it. As I was looking around for the shortest way to get out, he continued: "Yes; we have to keep the pressure up to 100 pounds on each boiler, and we have three boilers, so that makes 300 pounds." I breathed easier then, but didn't try to get any more information out of that man.

CHAS. B. SEGNER.

York, Pa.

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Piston Rings—Placing Lathes.

Editor American Machinist:

Although I have never had occasion to construct such rings, I think that Mr. F. A. Halsey, in his article on "Snap Piston Rings" in your issue of July 30th, fails to mention one of the chief objects of making the ring eccentric. The object of the "elaborate calculations" of which he speaks is not only that the shape of the ring shall be a true circle when in position, but that it shall bear with uniform pressure on all parts of the cylinder and wear evenly. By using a properly designed eccentric ring, turned and finished as explained by Mr. Halsey, both these objects may be attained.

I do not believe there is any entirely satisfactory method of placing lathes in a shop lighted entirely from the sides. The best satisfaction may probably be obtained by placing the back of the lathe toward the window, so the workman stands facing the light; and I think that lathes are usually so placed when circumstances will permit. In this way the workman is never in his own light, which is always a great annoyance to me, but one has to look toward the light, which makes it harder to see clearly the shaded parts of the tool and work when necessary.

A machine shop arrangement which always seemed to me to be about right in several large shops where I have seen it used, is to have a long shop of moderate width, with side-lights for the benches and sky-lights for the machine tools, the lathes being placed back to back in a double row along one side of the center of the shop, which is left open for the traveling crane. The larger lathes face this open space, being placed nearest the center of the shop; while the smaller lathes, drill presses, tappers, etc., face the row of benches along the side wall. Most of the other tools, planers, shapers, milling machines, etc., are placed on the other side of the open space, wherever they will be most convenient.

SPIRAL.

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Pedal-Bearing Drilling and Facing Machine—Drill Press for Bicycle Pedals.

We present, at Fig. 1 of the accompanying illustrations, an automatic machine designed especially for the purpose of facing and counterboring, simultaneously, both ends of bicycle pedal hubs for the ball bearings.

The machine has two sliding heads, each carrying two spindles—one for the roughing cut and the other for finishing. Cams placed on a worm-driven shaft beneath the bed move the heads at the proper time for feeding and give quick return motion.

The work holder is at the center of the machine, and provision is made for holding in it four pedal bars. The two lower ones are being operated upon by the tools, while finished bars are removed and replaced at the top. As the work-holding fixture is latched into position, the bar which is then brought into line with the spindles in front is roughed out and, at the next index position, is finished by the tools in the two rear spindles; these tools, since they do nothing but finish and take only a light cut, keep their form and edge well, and thus enable the machine to keep more steadily in operation than would otherwise be possible. A short dwell is provided for at the end of the cut, which dwell enables the finishing tools to make smooth-finished surfaces.

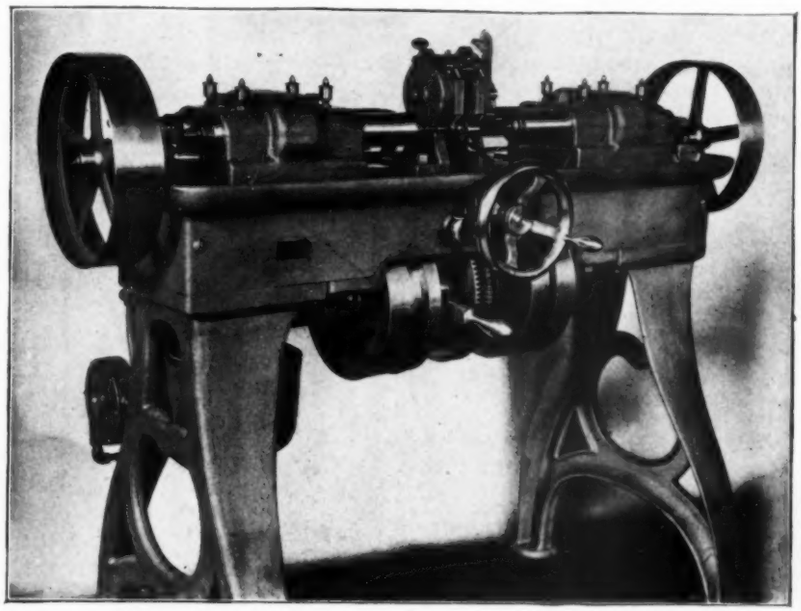

Fig. 2. PEDAL-BEARING FACING AND DRILLING MACHINE.

Lubricant is forced through the spindles to the ends of the tools, where it is effective, not only in lubricating, but in removing chips as well.

The second machine, shown in Figs. 2 and 3, is a drill press specially fitted up for drilling and milling to size the four arms of the pedal hubs.

The crank spindle hole through center of hub having been previously drilled and reamed, the first operation takes place on the machine shown at the right of Fig. 2. The bar is placed in a jig, as shown, and two spindles, properly spaced, drill the tap holes in the ends of two arms. The jig is then turned over to bring the other two arms into position for drilling in the same manner. The depth of holes is regulated by an adjustable stop on lower part of table.

The pedal bar, after being taken out of the box jig, is then mounted on the swivel holder, which is located on the table at the left of Fig. 2. This machine is provided with a head containing four spindles, two of these spindles carrying combination countersinks which make the bevel edge, also the body size bore of about 1-16 inch deep on the end of radial arm. These combination countersinks having a vertical readjustment can be set alike and therefore make the ends of radial arms uniform in length. After the above operation is done, the swivel holder is indexed ¼ of a turn, and the last operation is made with the hollow mills carried by the remaining three spindles. In this last operation the slight reduction of uniform size and length on end of radial arm is produced. All these different operations are controlled by stops on lower part of tables.

An oil-tank pump driven by a small belt is provided, and is so arranged that the oil for the drills is turned on when they come in contact with the work, and shut off when they are raised; this being accomplished by a small valve, the stem of which is attached to and moves with the drill table is shown at the rear of the machine, Fig. 3. The lower fixed table catches all the oil, which drains through a grid back into the oil tank.

These machines are made by the Langelier Mfg. Co., Providence, R. I.

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First Atlantic Steamships.

The National Museum has two interesting relics of the first steamship that crossed the Atlantic. One is a silver

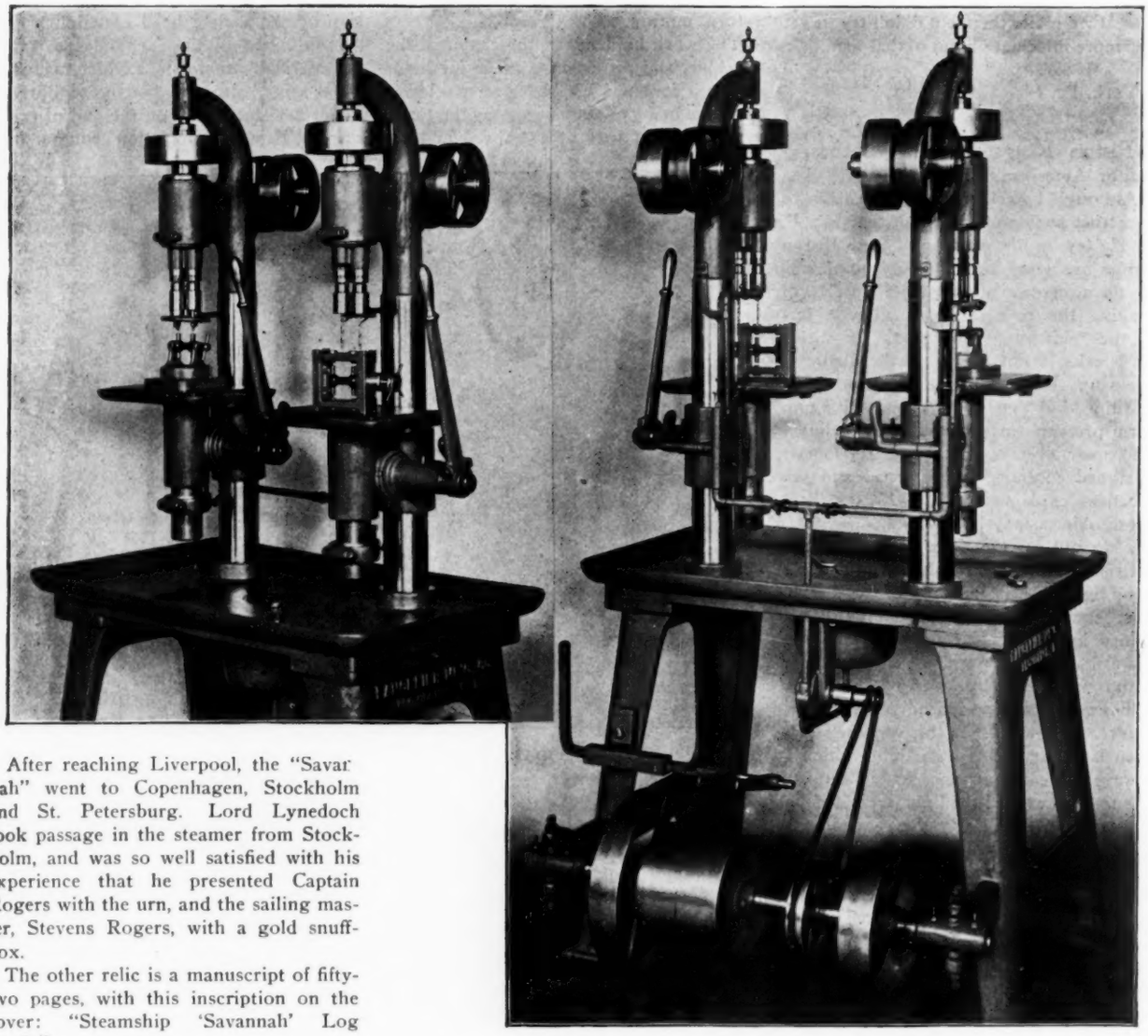
coffee urn which has this inscription: "Presented to Captain Moses Rogers, of the steamship 'Savannah,' being the first steam vessel that crossed the Atlantic, by Sir Thomas Graham, Lord Lynedoch, a passenger from Stockholm to St. Petersburg, September 15, 1819."

After reaching Liverpool, the "Savannah" went to Copenhagen, Stockholm and St. Petersburg. Lord Lynedoch took passage in the steamer from Stockholm, and was so well satisfied with his experience that he presented Captain Rogers with the urn, and the sailing master, Stevens Rogers, with a gold snuff-box.

The other relic is a manuscript of fifty-two pages, with this inscription on the cover: "Steamship 'Savannah' Log Book."

The Savannah was a vessel of 350 tons, built at Corlear's Hook, N. Y., and originally intended as a sailing packet. She was launched in August, 1818. Messrs. Rogers, who had been associated with Fulton and Stevens in early steamboating, induced a shipping firm in Savannah to purchase the vessel and fit it with engines. Her machine was built near Morristown, N. J., by Stephen Vail; the boilers were made at Elizabeth by Daniel Dod. The paddle wheels consisted of arms arranged to close like a fan. The arms could be detached and taken in when occasion required. It is said that the state-rooms were large and commodious. The crew was shipped from New London, Conn., where Moses Rogers was born, and the vessel left New York March 28, 1819, for Savannah, which place was reached April 6th. Between the 14th of April and May 22d she made a round trip to Charleston, and on the latter date left Savannah for Liverpool, arriving there June 20th; on the 3d of December she sailed for Washington, arriving there on the evening of the 16th. In 1820 an effort was made to sell the vessel to the Government; failing in this, her owners disposed of her by piecemeal. The Allaire Works, of New York, purchased the engines; and at the Great Exhibition in New York in 1856, the 40-inch cylinder was exhibited along with the log book. She ran as a sailing packet for a few years between New York and Savannah, but in 1822 went to pieces on Long Island shore.

Six years later the second steam vessel crossed the Atlantic, but it was not an American vessel. Four years later the third, built in Canada, arrived at London. The "City of Kingston" was the fourth steamship to cross (1838), followed by the "Sirius" and "Great Western" in the same year. The latter vessels have the distinction of having made the first steamship race across the Atlantic. The "Sirius" reached New York a few hours ahead of the "Great Western."



Figs. 2 and 3. DRILL PRESS FOR BICYCLE PEDALS.

Uses and Advantages of a Public Supply of Compressed Air.

BY FRANK RICHARDS.

Domestic Refrigeration.

With our air pipe laid down, and our supply of compressed air constantly at hand for use, the same as gas or water, by any one who wants it and can pay the price, one of the most obvious uses of it is for cooling purposes, or for maintaining at low temperature, not only water for drinking, but the many other things so necessary to our comfort and well-being under our modern and certainly improved mode of living. Ice is a necessity to us, and yet not in itself very

much, but almost entirely for its cooling ability. If compressed air can cool our drinking water and keep our provisions at low temperature for us, and if it can do this service for us as cheaply as it can be done by ice, then it is preferable to ice, because it will involve less trouble and annoyance than to have to do with ice. There will be no heavy blocks of ice to handle, no iceman to quarrel with, no water from the melted ice to take care of, no choking-up of refrigerator pipes, no unclean or unwholesome ice to contaminate our water. It will, then, certainly be interesting to inquire what will be the cost of this compressed-air refrigerator.

During the past summer ice has been furnished to retail customers in New York City for 40 cents per hundred pounds. This will serve as a starting-point, and it would seem to be a fair one, because we assume that our compressed-air supply will be established first in some large city, if anywhere, and therefore the cost of ice at the same point is what its service would practically come in competition with. The ice when received usually goes right into the family refrigerator, so that the heat that melts it is furnished by the contents of the refrigerator chamber, and they are cooled by the process of furnishing this heat for melting the ice. For melting one pound of ice into water, 142 units of heat are required, so that if the ice is used in a refrigerator, and for maintaining a temperature approximating 32 degrees Fahr. in it, the melting of the 100 pounds of ice will absorb from the refrigerator walls and contents 14,200 heat units.

Now, with our compressed-air supply, as we have assumed all along in these papers, maintained at a constant gage pressure of 100 pounds, and furnished customers at the uniform price of 5 cents per one thousand cubic feet of free air, the cost of the 100 pounds of ice, 40 cents, would be equal to that of 8,000 cubic feet of free air. The air pipe is carried to the refrigerator with the air at full pressure, and at the temperature of the outside air, and no precautions are required with regard to the pipe, and no protection or covering is needed. As the pipe, of course, runs through the ground, the temperature of the air as delivered will be somewhat lower than that of the external air in the hottest summer days, and we may assume for the air as it arrives at the refrigerator a mean temperature of 70 degrees Fahr. The air as it enters the refrigerator, or in suitable pipes running around the interior of it, is allowed to expand to atmospheric pressure, and a great fall of the temperature is the consequence. The temperature of the air at 100 pounds pressure before its re-expansion being 70 degrees, the theoretical temperature after the expansion to atmospheric pressure will be $-167°$, or, as we say, 167 degrees below zero. The ratio of absolute pressures before and after the re-expansion will be $15 \div 115 = .1304$, and for this ratio of pressures the ratio of absolute temperatures for air expanding without loss or gain of feet is .5541. The initial absolute temperature being $70 + 461 = 531$, the final absolute temperature will be $531 \times .5541 = 294.227$, and the sensible temperature will be, as above, $294 - 461 = -167°$.

This re-expanded and very cold air in the pipes around the interior of the refrigerator is to be raised, say, to a temperature of $+32°$ by absorbing or abstracting heat from the contents of the refrigerator, thereby cooling them just as the melting of the ice cools them. We will then have 8,000 cubic feet of air at atmospheric pressure to raise in temperature from $-167°$ to $+32° = 199°$. At the low temperature of re-expansion the volume will be less than 8,000 cubic feet; but our air is charged to us at 60 degrees, and it is 8,000 cubic feet at that temperature which is the basis of computation, and it is from that volume, at that temperature, that we get the weight of the air. The weight of one cubic foot of free air at 60 degrees being .0764 pounds, the weight of 8,000 cubic feet will be $8,000 \times .0764 = 611.2$ pounds. The specific heat of air at constant pressure, which in this case is atmospheric pressure, is .2375. This being required to raise one pound of air one degree in temperature, then for 611 pounds we will require $611 \times .2375 = 145.11$ heat units; and as the air is to be raised in temperature 199 degrees, we will require $145 \times 199 = 28,855$ heat units, or these heat units must be absorbed from the refrigerator and its contents. Our 100 pounds of ice, it will be remembered, only absorbed 14,200 heat units, so that the amount of compressed air that will cost the same to the consumer as the 100 pounds of ice will have double the cooling effect of the ice, or will be equal to ice at 20 cents per 100 pounds.

These computations seem to show quite clearly that for the large cities, where the compressed-air supply would naturally be established, if anywhere, there would eventually be a great many customers for the air for use in private houses and for domestic purposes. Of the details of piping and of the other arrangements by which the refrigerating power of the compressed air is to be applied, it is not necessary to speak here, and especially because I am not able to speak satisfactorily. Only experience can give us the details of successful practice. In the end the appliances that survived would differ greatly from those first thought of. Some difficulties would no doubt be at first encountered which we are not able now even to suggest. Some possibilities of refrigeration, such as ice has never brought us, would at once suggest themselves. Melting ice in the refrigerator is, of course, incapable of freezing other water, while with compressed air actual freezing would be easily possible. The refrigerator could be arranged with chambers of different temperatures, one of which would be a freezing chamber. Here it would be possible to freeze water known to be pure, in porcelain or other molds of suitable size and shape, into small portions of ice for use as required for drinking purposes. The freezer for ice-cream and water ices, instead of being, as now, a portable affair, with its nuisance of pounded ice and salt, and the salt getting into the cream, would become a part of the refrigerator, arrangements being provided for the necessary stirring and examination while the freezing was going on. Instead of any system of cooling pipes being required, it is quite probable that the compressed air might be discharged and expanded at once into the refrigerator chamber, thus securing in it a proper and probably desirable ventilation.

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A Pneumatic System of Lubrication.

While all mechanics realize the important place the lubricant holds in the successful operation of machinery, not quite all of them appreciate the value and importance of regularity and constancy of feed. Many have been in the habit of thinking that in the use of oil we could not have too much of a good thing; but it appears to be true with oil, as with everything else, that there may be such a thing as an excessive use of it, and the means of adjusting the supply at the point that is just right is in the interest both of smooth-running and of cheap lubrication.

M. G. Hombruch, an engineer, of Berlin, Germany, has invented and applied a system of lubrication that will be of interest to our readers. We are familiar enough with the various drop or sight-feed devices, and their introduction has worked a great advance in lubrication practice. One objection to them is that they can only be adjusted to uniform feeds, and that when so adjusted the feed will continue until the oil supply is exhausted, whether the machine is running or stopped. The arrangement which we illustrate embraces all the points which are to be lubricated on a given machine or engine in one system, and by its operation uniform lubrication is secured when the machine is running, and a cessation of flow when the machine is stopped.

The oil cup, one of which is applied at each place to be lubricated, is shown in Figs. 1, 2 and 3. The lubricating cup is formed of an upper part *A*, carrying an interior sleeve *c*, the top part of which, *d*, is funnel-shaped; and of a lower part *B*, in which is a central delivery tube *b*. The two parts are united as shown in Fig. 3. The cup *B* is filled with oil; the pressure of the air is applied by the tube *e* to the surface of the oil, and forces it to the tube *b*, which delivers it into the bearings. The air pressure being the same for all the cups, the consumption of oil is regulated by the size of the tube *b*, which is selected

of a size smaller or larger according to the size of the bearing to be oiled. The cups may be large enough to hold oil for a week's run, or longer. The height of the tube *b* is 2.4 inches. If the oil is to be fed for several days for one filling, the air pressure is slightly increased from day to day, a gage at all times showing the height of the oil in the cups.

Figs. 4 and 5 show the spiral pump by

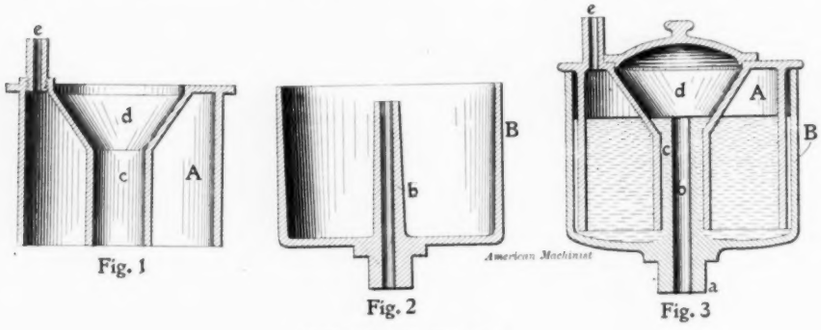

Fig. 1 Fig. 2 Fig. 3

PNEUMATIC OIL CUP.

which the air pressure is obtained. It will be seen to be practically a reversed Archimedes screw. The spiral tube *E* is placed upon a spindle *g*, which is hollow at its lower end and stands obliquely in the box *B*, which is partially filled with water. The spindle is turned by the worm gear *f*, which is connected with the moving machinery. A portion of air enters the upper open end of the spiral tube at each revolution, and escapes at the other side of the partition *h*, to be distributed by the tube *b*, connected to the various oil cups. The pressure obtained varies with the speed of the machine, and the distribution of the oil is therefore in accordance with the requirements.

The cuts and description above we take from "L'Industrie," feeling that many of our readers will be interested in the device. We confess that the description of its operation is not satisfactory, and we believe that a better one can be given, which we will not attempt until our readers have had time to look it over. The device is at least highly suggestive and well worth a little effort to understand it.

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Running Steam Cylinders Without Oil.

Steam engineers have of late been learning that the use of oil for lubricating steam cylinders and pistons is by no means an imperative necessity. It will be remembered that at the last New York meeting of the American Society of Mechanical Engineers this subject came up in connection with the discussion of the topical question: "What information can you give as to the best method for the extraction of oil from condensed steam where it is desirable to use the exhaust steam repeatedly for boiler-feed purposes?" In the course of the discussion it was made to appear that but little oil was really required for cylinder lubrication, and that cylinders might even be safely run without any. Mr. John Fritz, the present president of the society, spoke of one engine which had been run for a number of years without any oil in the cylinder.

We have been hearing lately more or less about the new torpedo boats for the United States Navy, and about the

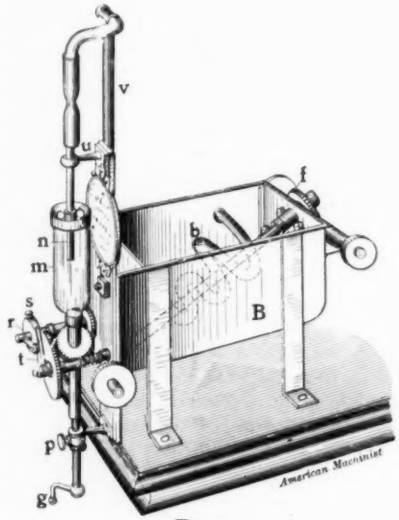

Fig. 4

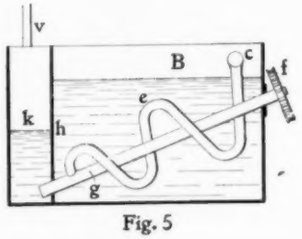

Fig. 5

AIR PUMP FOR PNEUMATIC OILING.

launching of the first lot of torpedo boats by the Herreshoffs. We have reliable information that upon those particular vessels the main engines, as well as the equipment of Blake steam pumps, are to be run without the use of oil in the steam cylinders, thus doing away with the necessity of carrying feed-water filters, and all risk of injury to the boilers from the presence of oil. While, as we have noticed above, the discarding of oil for steam cylinders is not an altogether new idea, it has not been the practice to run steam pumps without oil. The pumps furnished for the torpedo boats by the Geo. F. Blake Manufacturing Company are arranged without any oil holes whatever, so that it will be impossible to get oil into the steam cylinders. These pumps have been given an exhausive test for several days at the works, and they have operated with entire satisfaction and without using a drop of oil. This would seem to be an authoritative example, and it should at least secure a further experimental discarding of the objectionable practice of cylinder oiling.

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It is announced that Mrs. Julia Bradley, of Peoria, Ill., has bequeated $2,000,000 for the establishment of a polytechnic school in that city, to be connected more or less closely with Chicago University. The money with which the school is endowed comes from a fortune resulting from the growth of land value in the city of Peoria, Mrs. Bradley's wedding present having been a farm which is now in the heart of that city. The plan is to give to the school a large sum each year as long as Mrs. Bradley lives, and the whole estate at the time of her death.

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A writer to "Engineering," London, says: "The extra power required to machine steel, as compared with wrought iron, is generally attributed to the higher temperature at which the former is produced. Can any of your readers say what properties iron castings possess when the pig iron from which they are run has been raised to a steel-melting temperature, and then, before pouring, cooled to one just sufficient to keep the metal fluid?"

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About one-half of the entire copper product of this country is now refined by electrolysis—a fact which illustrates in a striking manner the progress of electricity in this field, which has been none the less rapid because but little noise has been made over it and but little is publicly known about it.

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Two fast express steamers building for the Hamburg-American Company have to meet a guarantee not only of 22½ knots on a six hours' speed trial, but the probably more exacting one of 21 knots as the mean of two years' steaming across the Atlantic.

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The engines of the American liner "St. Paul" are said to show such high economy—1.22 pounds of coal per I. H. P.—that some British engineers are suggesting that it is "too good to be true."

Comparison of "St. Paul" and "Lucania."

The "Marine Journal" contains an interesting computation, which has been made by Charles H. Haswell, on the relative speed merits of the American and British built steamships "Lucania" and "St. Paul," respectively.

The computation seeks to determine the handicap that the "St. Paul" would be entitled to by the rule governing steam-yacht racing, and takes into consideration their capacities as developed in the lines and proportions of their hulls, and by their engines, the accepted elements for the computation being as follows:

"Lucania" (British)—Tonnage, 12,952; grate surface, 2,200 square feet; pressure of blast, 1.5; indicated horse-power, 30,000; average hourly speed (recent passage), 21.37.

"St. Paul" (American)—Tonnage, 11,629; grate surface, 1,150 square feet; pressure of blast, 2.5; indicated horse-power, 20,400; average hourly speed (best passage), 21.08.

Working on these figures, according to prescribed formula, Mr. Haswell figures that the "St. Paul" has an advantage in proportions of hull, water lines and application of power.

Applying his figures to a recent trip of the "St. Paul," covering a course of 3,046 knots, it appears that if the "Lucania" had been coming over the same course she would have had to allow 231.2 miles, or 10 hours and 58 minutes, to the American boat. Her time over would have been 5 days 22 hours 32 minutes, or 1 hour and 59 minutes better than the "St. Paul's" (6 days 31 minutes); but the time allowance would have made the "St. Paul" a winner by 8 hours and 59 minutes.

The "Lucania's" average, however, of 21.81 knots, made when she beat the record from Queenstown by doing the passage in 5 days 7 hours 23 minutes, if maintained over the Southampton course of 3,046 knots, would make the time across 5 days 19 hours 39 minutes, or 4 hours 52 minutes better than the "St. Paul," lowering the "St. Paul's" figurative victory on time allowance to 6 hours and 6 minutes.

This would be still further lowered if the "Lucania's" "record average"—made over a longer course than her "record course"—of 22.01 knots were used. In that case, the "St. Paul" would win on time allowance by 4 hours and 50 minutes.

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The Hardie Compressed-Air Car.

Up to date the test of the compressed-air cars in One Hundred and Twenty-fifth street has been highly successful from a mechanical point of view. The cars have now occupied their place in the regular schedule for about six weeks. No delays have occurred which can be charged against the system, and a surprisingly small number from any cause—in fact, it would be difficult to name a new machine of any kind that ran more smoothly at its first trial. On but a single occasion has a car been towed home. That was due to the breakage of a pin, and in no way reflects upon the system.

The length of the round trip is 4⅜ miles, and the cars regularly make three round trips, aggregating 13⅛ miles, with one charge of air. On several occasions trips, aggregating 17½ miles, have been made with one charge, although this is only possible under favorable circumstances.

A thorough test of the economic performance of the plant is to be made, and its results will be awaited with interest. So far as mechanical performance is concerned, there is apparently little to be desired.

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Literary Notes.

ONE THOUSAND POINTERS FOR MACHINISTS AND ENGINEERS. By Chas. McShane (Practical Machinist), Griffin & Winters, Chicago, Ill. $1.50.

This is a book compiled by a machinist whose experience has been chiefly if not solely in railroad machine shops, and it contains little of much use to those whose work is in other fields. To the railroad machinist and engineer, however, the book should prove useful. There is little in it that is original or new, but it is mainly a compilation. It has been intelligently compiled, however, and the book ought to be worth its cost to machinists and engineers whose work is on locomotives.

PRACTICAL GUIDE FOR FIREMEN. By W. H. Wakeman. Seventy-four 4 x 6-inch pages; cloth binding; illustrated. Published by American Industrial Pub. Co., Bridgeport, Conn.

This is a book intended especially for the use of firemen of stationary steam plants, and gives practical directions on what to do in the boiler room, and how to do it, as well as what not to do. There are short chapters on "First Duties in the Morning;" "Carrying Fires and Removing Ashes;" "Steam Pressure and Water Level;" "Boiler Feeders;" "Receivers and Return Traps;" "Caring for Water and Steam Gages;" "Leaving the Boilers at Night;" "Boiler Inspection," etc. Mr. Wakeman is well known to our readers, and he writes from the standpoint of a practical man whose daily practice for years has been along the lines treated of in his book. The book will be useful to most firemen, and should help them to become good engineers.

We have received the first number of the "Journal of the American Foundrymen's Association," which is to be published monthly at 95 Griswold street, Detroit, Mich. This number contains a full account of the first meeting of the association, which was held in Philadelphia last May. The papers presented at that meeting are included, and comprise such as "Foundry Cranes;" "Air Compressors for Use in Foundries;" "Chemistry of Iron;" "How to Turn Out Good Molders;" "Green, Dry and Loam Sand Molding;" "Physical Tests and Chemistry of Cast Iron;" "Molding Machines and Their Applications;" "Cupolas and Cupola Practice;" "The Sand Blast," etc. There is also a "Review of Foundry Literature for the Month" (June), in which brief descriptions are given of leading articles pertaining to foundry matters as found in various journals. The new journal is ably edited by Secretary John A Penton. Its price is $5 per year.

We have received from the United States Industrial Publishing Company, 31 State street, New York, specimen pages of "The Manufacturers' Export Code," which is a very elaborate telegraphic code, adapted to the requirements of general business, and in which special attention is to be paid to the needs of machinery builders. The meaning of each code word is given in Spanish as well as English, thus making the code specially adapted for use by those who do business in South America.

We have received a copy of the "University Scientific Magazine," which is issued by the University of Tennessee, at Knoxville. The number contains, among other interesting articles, one which will interest draftsmen, since it is an illustrated exposition of the practice of a large number of drafting rooms in industrial and other establishments. Inquiry was addressed to the chief draftsmen of these establishments, asking for sample cards of letters representing what their experience had shown to be the best style, and the results are given.

The Brown & Sharpe Manufacturing Company have published in a separate pamphlet that portion of their "Treatise on Milling Machines" which treats of Compound Indexing. It makes a standard 6 x 9-inch pamphlet of 13 pages, and will be found useful by those who operate milling machines and wish to be able to index anything that comes along.

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Ball Bearings and Roller Bearings in Grist Mills.

"There appears to be a growing belief that ball bearings could be employed with advantage at many points in a flour mill. The change would necessitate new patterns and processes in the shops where mill machines and machinery are made, and that means a money outlay, which in these times is a consideration of unusual weight. Nevertheless we predict a "strike" for the house that first brings out a line of ball-bearing machines, hangers, etc."—"The Roller Mill."

[There can be no question about it. The modern roller mill is a place where the ball bearing or roller bearing would seem to be especially applicable, and our esteemed contemporary may very safely predict success to those who have the enterprise to make the application.—Ed. A. M.]

American Machinist.

Published every Thursday
by the
American Machinist Publishing Co.,
256 Broadway, New York.

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C. P. Day, Manager Adv. Dept.
Fred J. Miller, Editor.
Frank Richards, F. A. Halsey, Edward P. Buffet, } Associate Editors.
A. L. Donnell, Dept. of Illustration.

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Space in advertising pages only is for sale.

We invite correspondence on subjects pertaining to machinery.

Name and address must always be given, though not necessarily published.

Communications for or relating to the reading columns should be addressed to the Editor. All business communications should be addressed to the Company.

Subscribers can have their mailing address changed as often as they desire. Send both old and new addresses. Those who fail to receive their papers promptly will please notify us at once. Date on wrapper denotes week with which subscription expires.

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Ball-Making.

We devote a large share of this issue to a full description of ball-making methods as pursued in one establishment, under the direction of a mechanic who is pre-eminent, and whose methods are always highly suggestive and instructive. Real mechanics will readily recognize the value of such an article, even for those who may never have anything to do with steel ball making. Ideas used in any given line of manufacture are seldom wholly or even mainly original. They are usually adaptations from other lines, and the mechanic who would be well informed, ready in expedients, and competent to cope with the problems of his business as they arise, cannot be too well acquainted with what is done by other skillful and successful men, even in lines of work that seem quite different. This present article is brimming full of valuable ideas that can be applied in many ways, and in the manufacture of many articles differing widely from the particular line to which it refers.

It is evident that balls are coming into quite general use, especially for thrust bearings, for which they seem especially adapted. What they may do in some cases is shown by the experience of a friend of ours who, some time ago, designed a machine, the principal element of which was a screw, about 3 inches diameter, 1½ inches pitch. This screw was driven by bevel gears and a double friction clutch, and its office was the usual one of such an arrangement, i. e., to exert pressure. The pressure required for the work could not be very accurately determined in advance, and was consequently guessed at to some extent; with the result that when the machine was completed and put in operation it seemed to be a failure—it would not do the work required of it. The old method of getting over this difficulty would have been to put on larger and wider pulleys to force things, and then stronger clutches and gearing to stand the belts; but as it was, two grooves were turned and plain hardened steel rings put into them, between which were placed thirty-four ½-inch steel balls—and lo! the machine was and is a complete success. In fact, it was afterwards found advisable to reduce the width of the driving belts.

Many similar instances might be given, and a device that can do such a thing for the machinist is and must be important to him, aside from his interest in the methods employed in its manufacture.

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One Reason for the Reputation of the Corliss Engine for Economy.

It is, of course, well known that there is no reason why the Corliss engine should give any better economy of steam than a number of other valve motions, other conditions being the same; but, nevertheless, the reputation of the Corliss gear for economy is so great that it has practically crowded all other releasing gears out of the market. We know of one manufacturer who deliberately laid aside his own gear and adopted the Corliss, although he considered his own construction the best. Experience showed that it was impossible to make headway against the reputation of the Corliss motion, no matter what the merits of another construction might be. There can be no doubt that the reputation of the Corliss motion for superiority in a field where it really has no superiority is largely responsible for its commanding position to-day, and it is a matter of interest to inquire into the reasons which gave it this reputation.

In the early days, when this reputation was being made, the gear was made exclusively, as it still is chiefly, with a single eccentric. With a single eccentric the latest cut-off under the action of the governor is still fairly early, and when a proper margin is provided for occasional extra loads, the usual working cut-off is of necessity at an economical point. This consideration compelled the putting-in in every case of an engine large enough to handle its load economically. If the engine were not large enough to do this, it simply had to come out, as it would not act.

Had the Corliss engine been fitted at the start with two eccentrics, so as to have a long range of cut-off, there can be no doubt that the constant pressure to make a small engine do a large engine's work would have prevailed in many cases. The result would have been a lower economy in those cases and a corresponding injury to the reputation of the engine.

In no one thing does the sound judgment of Mr. Corliss show itself more clearly than in thus building an engine which could not be made to give poor economy. He made it a case of good economy or a larger engine, and the results are before the world.

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Scientific Illiteracy.

Some time ago there was some discussion of what was called "Scientific Illiteracy," and some of those who took part in the discussion claimed that there was a very deplorable lack among scientific and technical writers of that kind of education which enables men to choose the best forms of expression, construct grammatically correct sentences, etc. We ourselves were, it seems to us, undeservedly complimented during the discussion; but be that as it may, the fact is that most men who have studied any art or science sufficiently to have anything to say about it worth saying in print, have been unable to also devote much study to the science of language and to the niceties of syntax. Ideas and exact information are far more important in technical writing; readers for whom such writing is intended being usually willing to overlook mere slips of the pen, or errors in grammatical construction, if only the ideas and the information be not lacking.

In this connection it may be interesting to mention that a friend of ours who was at one time connected with a journal whose editor, contributors and readers were almost exclusively college men, informed us that many communications were received from graduates and under-graduates which were totally unfit for publication on account of bad orthography and worse syntax. From an inspection of the publication referred to, we certainly would not be willing to concede that there were ideas to compensate for these shortcomings, and, on the whole, we think the scientific and technical writers do not compare so very unfavorably with others, excepting those whose business is literature and whose literary skill is their only warrant for writing at all.

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It having been reported that an officer of the Russian Government, assigned to duty as inspector during the manufacture of armor plates at the Homestead Works, had become acquainted with the secret processes of manufacture, and had given them to his own government, with the result that no more orders for such plates could be secured here, the report was later denied by the superintendent of the

works, who stated that none of their secrets had been stolen, and that the truth is there are very few secrets to steal.

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Questions and Answers.

Name and address of writer must accompany every question. Questions must pertain to our specialties and be of general interest. We cannot undertake to answer questions by mail.

(171) M. K., Garwood, N. J., asks: I should like to know if there are any means for truing the centers of a spindle which is hardened all over, but is found, after being ground, not to be quite true. A.—If the piece is not too much out, it can be trued by means of a copper lap, which lap is simply a piece of copper wire held in a drill chuck in the speed lathe, the point being turned in place to correspond to the centers, i. e., 60 degrees. This lap can then be charged with flour of emery and oil, and by marking the proper side of the piece the work can then be held on this revolving lap and pressed against it laterally in such a way as to throw the center over; the final operation being, of course, to feed the work up to the lap in order to make the centers truly conical and true with each other. Where work is to be thrown over very much by this method, considerable time and patience are required, and whether it is worth doing in any case must depend upon the value of piece to be corrected.

(172) A correspondent whose signature is an undecipherable monogram, writes: In answer to question No. 167, September 17th, with steam pressure 100 pounds (doubtless meaning boiler pressure) the mean effective pressure is reckoned at 80 pounds; is not this decidedly wrong? I think it is commonly placed at one-half the boiler pressure. A.—In the case referred to the mean effective pressure was purposely assumed lower than the conditions warranted, instead of being, as our correspondent suggests, much too high. The valve was a slide valve, cutting off not before three-quarter stroke, and with steam at 100 pounds the tabulated mean effective pressure for three-quarter cut-off is 94 pounds; so that if we had assumed 85 or even 90 pounds, instead of 80, we would have had sufficient warrant for so doing. With automatic cut-off engines, presumably running with reasonable economy, but where the point of cut-off is not known, it is quite common to assume the mean effective pressure at one-half the boiler pressure. We are sorry that our correspondent is unable to give us the other reference, and hope that he will yet be able to find it and bring it to our notice over his signature.

(173) G. T. A., Munhall, Pa., writes: I wish all the information I can get on testing the hardness of steel. I am trying to find some way to establish beyond doubt that one piece of steel is harder than another when both pieces are known to be exceedingly hard. The results as shown by physical tests, or trial by means of a center punch, do not show anything in our particular case. A.—We are of the opinion that no satisfactory test for the hardness of hardened steel has ever been devised. As the standard test of the comparative hardness of minerals is by scratching them with different substances, why might not this be applied with more or less satisfaction? There is no steel so hard that the emery wheel will not cut it, and at the same time everyone knows that the wheel cuts hard steel much more slowly than it cuts softer steel. There would seem to be in this fact all the essential conditions for a tolerably satisfactory test of steel hardness. The steel dust made, the reduction in thickness of the piece of steel at the place where it was ground, or the abrasion of the wheel itself in a given time, would all be in evidence, and surely such evidence might tell us much.

(174) J. T., Chicago, asks: 1. Where is the neutral axis located in different sections, and when does it come on the bottom of a section? A.—The neutral axis is always at the center of gravity of the section, and hence can never be at the bottom. 2. Should the compression flange be as large as the tension flange in cast-iron beams when we are figuring on deflection and not on breaking? A.—The heavier tension flange is practically the result of a transfer of surplus strength from the compression flange to the tension flange, where it is needed. It enables the beam to carry a heavier load without breaking. We do not think any absolutely general statement of the effect of the transfer on the stiffness of the beam can be made; but with the limitation that the transfer shall be so made as not to disturb the position of the center of gravity of either flange, the deflection of a beam with equal flanges will be less than that of a beam of unequal flanges of the same aggregate cross-section. 3. Explain how to calculate the moment of inertia of various sections. A.—Moments of inertia of all cross-sections in common use may be found in all engineers' pocket books. Their exact calculation requires the use of the calculus. Results which are sufficiently accurate for practical purposes may be found by the method explained by Mr. Ferris in our issue of April 16th. 3. What should be the shape of a beam supported at one end and loaded at the other for a uniform bending strength, not breaking strength? A.—A beam of uniform strength is one which is so proportioned that the strain at the outer fiber is the same at all points of its length, and, as we understand your question, the form in both cases is the same.

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Business Specials.

Transient Advertisements 40 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Gear wheels, gear cutting. Grant; see page 9.

Forming Lathes. Mer. Mach. Tool Co., Meriden, Ct.

Milling Machs. Kempsmith Co., Milwaukee, Wis.

Engine Castings ⅛ to 2 H. P. Finished boilers and engines. Grant Sipp, Paterson, N. J.

Selden Packing for stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., N. Y.

Duplex and special gear cutters, counterbores, cutter and surface grinders, vertical millers, hand punches and shears. R. M. Clough, New Haven, Ct.

Patent Soliciting of High Class.—D. Walter Brown, Counsel in Patent Cases, 111 Broadway, New York. Send for "Brief History of Patent Legislation."

Notice—The dissolution of the George Place Machine Co., through a receiver, in no way affects me or my regular business, as I had no financial interest in the company. My name has never been, nor is it now, on any of its obligations. Owing to the corporate name under which the company has been doing busines, I thought it best to make this explanation. Very respectfully,

GEORGE PLACE.

New York, September 19, 1896.

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It is reported that the E. W. Bliss Company, of Brooklyn, N. Y., is about to secure a contract with the Government for the construction of one hundred Whitehead auto-mobile torpedos. The contract amounts to nearly $250,000.

An Irrepressible Inventor.

In a recent issue of the "Nineteenth Century" Sir Wemyss Reid gives some reminiscences of Newcastle-on-Tyne, and shows the beginning of the hydraulic crane and of a world-renowned inventor:

"As a youth (he says) I remember a plain house in Westgate street, upon the door of which was a worn brass plate bearing the words, 'Mr. Armstrong, solicitor.' The Mr. Armstrong of forty years ago was an eminently respectable member of his profession. Some good people, it is true, shook their heads when they heard that instead of attending to conveyances and writs and mortgages, he had taken to dabbling in mechanics. Not that way does fortune lie in the profession of the law. But one day I was taken as a boy to see a remarkable new toy—it seemed nothing more—that had been placed upon the Quayside at Newcastle, where a few small steamers and Dutch merchantmen were in the habit of coming with cargo. It looked like a metal box, with some curious handles, not unlike water taps, upon the lid. A good-natured workman turned one of these handles, and lo! as he did so, a great crane hard by rattled its chain, and slowly but surely swung a heavy load into the air. It was like magic. 'Now try it yourself,' said the man, as he stopped the movement of the crane. Timidly I moved the handle, and straightway the miracle was repeated. At the touch of a child the heavy load was at once borne upwards. 'It's arl dunne by watter,' said the man, 'and it's Armstrong, the solicitor, in Westgate street, that's invented it." That was the first hydraulic crane. 'Mr. Armstrong, solicitor,' had found his true calling in life. He still kept up the practice of his profession. But he bought a small bit of ground by the side of the Tyne, away from the town, on the Scotswood road, and there he raised a modest building, within which the manufacture of his new hydraulic machinery was undertaken. From that humble beginning of more than forty years ago has sprung the vast Elswick establishment, which knows only one rival in Europe. Fifteen thousand workmen are busy from day to day at furnace, forge and lathe. Of course, the place had begun to make great strides forward before I left Newcastle in 1862. The famous rifled gun had been invented, and was becoming almost as important an article of manufacture as the hydraulic cranes and rams. But since then the development of the establishment has been almost appalling, and I could not recognize the scenes once so familiar. It is 'Mr. Armstrong, solicitor,' now Lord Armstrong, who has given the impetus to the industrial progress of the Tyne."

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American competition in the cycle trade is announced. A Birmingham correspondent who has business connections on

the Continent has recently been staying in Berlin, and on his way visited a few Dutch towns. Whilst traveling, he was much struck with the rapid and increasing sales of American cycles in Germany and Holland, and in Berlin especially a very large number of American machines are to be seen, whereas six months ago they were, comparatively speaking, unknown. He was told that at nearly all the cycle depots the sales of American machines were on the increase. The correspondent continues "If wooden rims and very light machines are the demand on the Continent, it surely behooves those engaged in the cycle industry to go with the times." A friend—the representative of a large house dealing in agricultural implements—once told him, and it is more true now than ever, that the American makers of agricultural implements had almost completely ousted the English manufacturers of reapers, binders, etc., in Germany, Russia, Austria and Hungary. The English firms would not listen to the advice tendered them by their agents in great cities and centers, and would not adopt the methods of the Yankee makers, with the consequence that orders were lost and the trade went to the States. It is to be hoped that this will not be the case with the cycle industry.—"The Engineer."

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It is reported that the two Japanese naval constructors who have been in the United States for some time past, looking into the matter of plans and specifications for two cruisers for the Japanese Government, have reported favorably upon the bids tendered by Messrs Cramp and the Union Iron Works, and the formal award of the contracts will be made in a few weeks. Each of these vessels will be of about 5,000 tons displacement and have a speed of about 20 knots.

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It is stated that the Hamburg-American liner, "Augusta Victoria," is to be lengthened 60 feet, giving her a total length of 520 feet. The extra space thus obtained will be utilized in part for extra boiler capacity, by which the speed of the vessel is to be increased about ½ knot. The method of procedure will be to cut the vessel in two, drawing the parts asunder, and putting in a new frame and plates to fill the gap.

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We are informed that some time ago the Straight Line Engine Company, Syracuse, N. Y., did some work for the Solvay Process Company, for which work the traversing machine of Professor Sweet's design was specially adapted. Afterward the Belgian works of the Solvay Process Company wished some similar work done, and it was sent to Syracuse to be done in the same manner and on the same machine.

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A board of naval engineers has been making extended experiments on the use of oil as fuel in naval vessels, and it is stated the report is now before Commodore Melville. Though at this writing little is known definitely of the tenor of the report, it is thought to make a favorable showing in favor of at least tentative experiments in the use of oil fuel in smaller naval vessels.

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Lieutenant Joseph Strauss, of the Navy, has devised a substitute for hydraulic cylinders for taking up the recoil of heavy guns. He uses springs and, it is said, reduces the complication of the mechanism, and makes a device more reliable than the hydraulic cylinders.

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In France, more factories are driven by water power than by steam. A total of 118,655 workshops are enumerated, 59 per cent. of which use water. The hydraulic plants are much smaller than those run by steam.

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A good knowledge of arithmetic is more useful to a craftsman than to be a good speller; but still, the draftsman who marks his drawing "Driveing Geare Leaver" is somehow frightfully handicapped in the race for advancement.

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Some machinists are much given to the use of the spirit level in setting work. It would be interesting to observe what such a man would do in the machine shop of a naval vessel.

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The compound engines of the White Star steamer "Germanic," recently replaced by triple expansions, had driven the ship across the Atlantic 422 times, or over 1,000,000 miles.

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Commercial Review.

NEW YORK, SATURDAY EVENING, SEPT. 26TH.

ENGINES AND BOILERS.

It is almost dead low water in the engine and boiler trade. Many of the buoys in the channel are still fixedly pointing downward, while a few are twitching about in a way that may indicate the presence of incipient up-currents. In plain language, there are occasional reports of improvement, but they are fully offset by those which point the other way. A better inquiry and even a better demand are experienced by some, due partly, perhaps, to engineers, contractors, etc., having gotten down to work again after the vacation season, or for the reason that the results of the election are being discounted in advance.

But appearances indicate that the buying side of the market is in general as cautious as hitherto, if not more so. Investors no doubt feel, as with propriety they may, that after business has already been in a hesitating condition so long it would be foolish to place their contracts now when they have so short a time to wait before learning what it is upon which they must reckon.

The demand from office, and other metropolitan buildings, this month and last has been quiet. An order placed a few weeks since for a steam plant for the Telephone Building, and which went in customary channels, is about the latest one that has come to our notice.

WHEN BUSINESS STARTS UP AGAIN,

how will it act? This, to be sure, is conjectural, but one opinion has been suggested which contains so much common sense that it will bear repetition. It is, that after confidence is restored the really necessary orders which are now hanging fire will quickly be placed, causing a spurt of activity; then will come a reaction to dullness, and after the first of next year trade will begin to pick up afresh. So the new and aggressive enterprises projected may take things in rather a leisurely manner.

A SIGN OF THE TIMES.

Contracts contingent upon political events are now referred to once in a while by the daily press. The following story told us by one of the parties immediately concerned is a clear-cut example of the fears which are hurting business: A certain Pennsylvania company who make high-speed engines for electric purposes received an order from a Southern electric plant, for an engine of something like 150 horse-power to be ready for shipment November 4th. But the contract was conditioned upon the election of Mr. William * * * the day before, and if Mr. William * * * were elected instead it was to be canceled; and not only that, but in the latter event the otherwise purchasing party were to place two engines on the market themselves. Whether the offer was accepted, is a fit subject for conjecture.

DOING BUSINESS AT LONG RANGE.

The Sultan of Koetie has ordered an Ames boiler. Koetie is on the island of Borneo, and it is said that the boiler will be used for plantation purposes. One of the most prominent high-speed engine companies in this section reports an improved trade this year with China and Japan. Five of their engines have been shipped, we believe, to the Far East within the past month. And as to foreign trade on this side of the water, Frank McSwegan & Son, of this city, inform us that they have just sent off a steam plant, containing engine, boiler, pump and heater, to Mexico, to be used in connection with gold mining. Elsewhere are rumors of inquiries from Mexico, South America, Porto Rico and South Africa.

FOREIGN DEMAND FOR MACHINE TOOLS.

Among the manufacturers of machine tools who have been abroad this season is Mr. Fred. A. Geier, secretary and treasurer of the Cincinnati Milling Machine Company. We have received from him the following interesting letter upon the outlook for American tools in Europe: "The writer found that the demand in

Europe for American tools at the present time was greatly augmented by the fact that English as well as German tool builders are exceedingly busy, and the prompt deliveries on American tools, in many cases securing the order. There is now, and will continue to be for quite a number of years, a good demand for American tools of the best grades on account of their superiority over European types. Some of the best builders of tools on the Continent, however, are closely imitating our designs and putting in the very best of workmanship. These tools in many instances, however, cost more than the American. These builders are greatly increasing their facilities, and the American builder will find the competition at their hands growing keener all the time. It will be necessary for the American builder to study this foreign market closely and adapt his machine to the requirements of the foreign buyer."

In addition, Mr. Geier is able to report some favorable signs in the situation at home: "In the domestic market, this last week (his letter being dated September 24) has shown a decided improvement; among others, three orders having been secured which have been hanging fire for months. We are optimistic enough to believe that these are the result of a belief on the part of our customers that the battle for sound money has been won and that November will simply give us official returns."

ET CETERA.

A marked industrial activity in England is reported by a gentleman connected with the steel trade, who has returned from that country. In Liverpool and elsewhere machinists are in demand for shipbuilding, etc. A certain English house dealing in American tools, he reports to be very busy.

The United States Consul at Furth thinks many thousand American bicycles can be sold next spring in Bavaria.

Export shipments of machinery from New York, as per Custom House reports made during the week ending September 26th, amounted to $168,380.

IRON AND OTHER METALS.

The iron market continues to show signs of improved tone. Both are the sales of pig iron fairly good, and a number of mills, including the entire plant of the Carnegie Company's Edgar Thompson Steel Works, at Braddock, have resumed operations.

It was reported this week that Mr. John D. Rockefeller is endeavoring to consolidate the Pennsylvania and Ohio pig iron furnaces with the purpose of perfecting, ultimately, an organization similar in plan to the Standard Oil Company, and that many of the larger companies had agreed to it through fear. The union of the iron interests is a difficult undertaking, and some doubt as to its accomplishment, even by Mr. Rockefeller, is to be entertained. A prominent authority upon the iron market has suggested to us, however, as a reasonable conjecture, that it would not be strange if the Carnegie and Illinois steel companies and the Rockefeller mining interests should prove to be working in harmony and should effect an arrangement controlling the price of rails, etc., perhaps of structural material.

As usual, inactivity has characterized the metal trade.

Pittsburg Report for September.

The condition of the iron and steel trade at present is pretty well understood. Within the past few weeks there has been a slightly better feeling prevailing, and this will probably continue until the November election, after which, it is thought by many, a decided improvement will be felt.

A large amount of work has been stopped by reason of the national campaign. Quite a number of large steel plants are under consideration, both in this city and at other points, but they are now laid on the shelf until after election. A well-known engineer in this city, who had begun on plans for a large steel plant, has been compelled to lay them aside, because the company could not dispose of some bonds. It is difficult to estimate how much work has been lost or postponed in this way. The want of money or the want of confidence, which is the same thing, has put a stop to a great amount of work. People who, in such times as these, make inquiry as to the cost of hypothetical contracts may place orders if they get everything below market value, but the man who is asked to pay a dollar for a dollar's worth is likely to lay his dollar away until after election at least.

The drop in business has been quite marked since this time last year. About 30 or 50 per cent. of the iron and steel finishing capacity is now unemployed. This, in turn, causes great dullness among the branches of industry which furnish mill machinery and supplies.

Figures show that the production of pig iron has decreased steadily since the beginning of the year, while prices have also reached a very low point.

In the engine, boiler, heater and allied

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Help Wanted.

Situation and Help Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. The Cash and Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

TO SUBSCRIBERS

whose names appear on our **subscription** list, this paper will give two free insertions under this heading to those in want of positions. The advertisement to occupy a space of not more than five lines. Additional space or insertions must be paid for in advance at regular rates.

Mechanical draftsman desires position; good references. Box 78, AMERICAN MACHINIST.

Experienced mechanical dftsman, wants position; best references. Box 81, AMERICAN MACHINIST.

Wanted—By comp't machinist, opportunity to go to South Africa to erect machy. Box 82, AM. MACH.

Comp. draftsman, grad. wants pos.; exp. in design'g engs., boilers, gen. machy. E. P., AM. MACH.

Expert draftsman, experienced machine designer, open for engagement. Box 73, AM. MACH.

Foundry foreman with considerable experience wants pos.; American; best refs. Box 76, AM. MACH.

Machinist, also mechanical draftsman, desires position; will work two weeks free to show ability; German; speaks little English. Box 80, AM. MACH.

Wanted—For Ohio city, thoroughly reliable and competent man to take charge of die department; none other need apply. Address, with full particulars, Box 83, AMERICAN MACHINIST.

Wanted — A first-class man to run automatic screw machines; also a first-class tool maker; both must be of good habits. Apply at once, to William L. Gilbert Clock Company, Winsted, Conn.

I would like to hear from party desiring service of thoroughly up-to-date foundry foreman on light or heavy work; if you need such a man, drop me a line and get full particulars; good references. Box 84, AMERICAN MACHINIST.

Superintendent would like to correspond with parties requiring the services of a man of thoroughly practical and executive ability; extensive experience in the designing and manufacture of bicycles, special tools, etc. Box 75, AM. MACH.

Tool maker, machinist, steady, experienced in tool room, shop machinery and repairs, tools for screw machines, turret lathes and milling machines, used to micrometer, measurements and drawings, wants position. Box 74, AM. MACHINIST.

Wanted—A thorough reliable mechanic, able to take charge of milling, drilling and screw making department of large cycle works in the North of England; latest American machines used; only men having the very best experience need apply. Address Elswick Cycles Co., Ltd., Elswick Court, Northumberland St., Newcastle-on-Tyne, England.

Wanted—For large cycle works in the North of England, a first-class head tool maker; one who thoroughly understands the construction of the latest and most approved tools for the production of parts by automatic and other machinery; best American makes; only a steady, reliable and energetic man need apply. Address Elswick Cycles Co., Ltd., Elswick Court, Northumberland Street, Newcastle-on-Tyne, England.

Business—A gentleman with means and undoubted reference would like to form a connection with parties desiring to be represented in the Pacific States. The party is more particularly conversant with machinery, but has spent many years in mercantile pursuits. State in answer line of manufacture you desire to introduce. Address P. O. Box 2055, San Francisco, Cal., and if satisfactory, correspondence or personal visit will follow.

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Miscellaneous Wants.

Advertisements will be inserted under this head at 30 cents per line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Cheap 2d h'd lathes & planers. S.M.York,Clev'd,O.

Calipers & Gauges. F. A.Welles, Milwaukee,Wis.

Best and cheapest Bolt Header, made by Baush & Harris Machine Tool Co.

Light and fine mach'y to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

For Sale—Second-hand drill presses,engine lathes & planers. Dietz, Schumacher & Boye,Cincinnati,O.

We make a specialty of Shartle's patent safety set collars. Prices low and samples free. Middletown Machine Co., Middletown, Ohio.

We offer an exceedingly fine lot of first-class second-hand machinery, lathes, planers, shapers, drills, millers, screw machines, etc. Call, or get list 17 B. The Garvin Mach. Co., 440 Canal st., N.Y.

Wanted—Cylinders and working drawings for triple expansion marine engine for launch; cylinders about 4 in., 7 in. and 12 in. x 6 in. stroke; boiler pressure, 200 lbs. Send price and description to G. H. Davie, P. O. Box 213, Erie, Pa.

Wanted—An Idea. Who can think of some simple thing to patent? Protect your ideas; they may bring you wealth. Write John Wedderburn & Co., Patent Attorneys, Washington, D. C., for their $1,800 prize offered to inventors.

trades, a moderately fair business has been done. Some establishments whose dealings are with the minor lines of industry have had a fairly good summer, because their customers had to keep up some degreee of activity. Heyl & Patterson, builders of coal conveying machinery, have been doing considerable work, due almost entirely to the construction of by-product coke plants.

Many electric light and water works plants are being built. Bids will soon be asked for the new plant at Sharpsville, Pa. The contract for the Coraopolis water plant was awarded Chandler Bros. & Co., of Beaver Falls, while the new electric plant for the Public Safety Building, in this city, will be furnished by the Westinghouse Machine Company. The McCool Tube Company, of Beaver Falls, is now erecting a plant at that place which will be equipped with the most improved machinery. The power plant will consist of a pair of 33-inch iron-cased McCormick turbines, manufactured by the S. Morgan Smith Company, of York, Pa. These wheels will be direct-connected to an electric generator. In connection with the water wheels, a heavy fly-wheel and a combined electric and mechanical governor, which will regulate the speed of the turbines, are being furnished. The drawing machinery will be of special make and of an entirely new design. The company claim that the plant will be the best equipped possessed by any tube concern in the country, and will make tubing at nearly one-third the present price and of a superior quality.

Quotations.

NEW YORK, Monday, September 28th.

Iron—American pig, tidewater delivery:

No. 1 foundry, Northern	$11 75 @ $13 00
No. 2 foundry, Northern	11 25 @ 12 00
No. 2 plain, Northern	10 50 @ 11 00
Gray Forge	10 50 @ 10 75
No. 1 foundry, Southern	11 25 @ 11 50
No. 2 foundry, Southern	10 75 @ 11 00
No. 3 foundry, Southern	10 25 @ 10 50
No. 1 soft, Southern	10 75 @ 11 00
No. 2 soft, Southern	10 75 @ 11 00
Foundry forge, or No. 4 Southern	10 00 @ 10 25

Bar Iron—Base—Mill price, in Carloads, on dock; common, 1.10 @ 1.15c.; refined, 1.20 @ 1.35c. Store prices: common, 1.40 @ 1.50c.; refined, 1.50 @ 1.80c.

Tool Steel—Ordinary sizes, standard quality, 5½ @ 7c.; extra grades, 11 @ 12c.; special grades, 16c. and upward.

Machinery Steel—From store, 1.65 @ 1.75c. Special brands upward.

Cold Rolled Steel Shafting—Base size in carloads, about 2½c.; 2¾c. for smaller quantities from store.

Copper—Carload lots, Lake Superior ingot, 10¾ @ 10⅞c.; electrolytic, 10½ @ 10⅝c.; casting copper, 10¼ @ 10½c.

Pig Tin—For 5 and 10-ton lots, 13.10c., f.o.b.

Pig Lead—In carload lots, offered at 2.80c., f. o. b.

Spelter—In carload lots. New York delivery, 3.60 @ 3.75c. for various Western brands.

Antimony—In wholesale quantities, Cookson's, 7 @ 7.25c.; Hallett's, 6.40 @ 6.50c.; Japanese, 6.40 @ 6.50c.

Lard Oil—Prime city, present make, commercial quality, in carload lots, 38 @ 40c.

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Manufactures.

Bennett, Pa., is about to erect large water plant.

The city of Bellevue, Pa., will erect a water plant, and place new machinery.

Norwich, Pa., will erect a water works, and install new and improved machinery.

The city of Reading, Pa., will erect a garbage disposal plant, and install machinery.

(*Continued on page 39.*)

Just Published. Two Reliable Books.

"SHOP KINKS,"

By ROBERT GRIMSHAW. Showing special Ways of Doing Work Better, more Cheaply, or more Rapidly than Usual.

400 Pages, 225 Illustrations, $2.50.

"THE MODERN MACHINIST," By JOHN T. USHER, Machinist.

320 Pages, 257 Illustrations, $2.50.

☞ *Illustrated circulars of both sent free.*

NEARLY READY.

"GAS, GASOLINE AND OIL ENGINES,"

By GARDINER D. HISCOX, M. E.

400 Pages. 200 Illustrations. Price, $2.50.

This book treats comprehensively, and almost entirely of American makes of Gas, Gasoline and Oil Engines, with instructions for the care and management of the same.

Our Catalogues of Books for Machinists, Engineers, Electricians, etc., also sent free.

NORMAN W. HENLEY & CO., Publishers,
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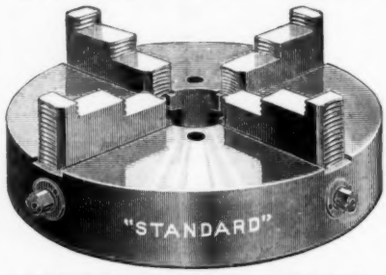

INDEPENDENT CHUCK

IS THE STRONGEST AND BEST.

Solid Shell. Solid Reversible Jaws.

Also Mfrs. of the CELEBRATED SWEETLAND COMBINATION CHUCKS....

The Hoggson & Pettis Mfg. Co.

New Haven, Conn., U. S. A.

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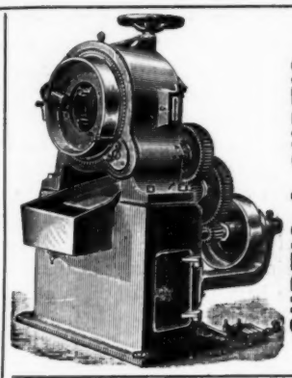
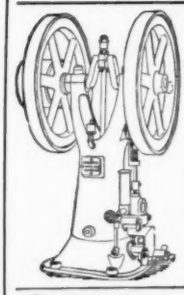


CURTIS & CURTIS,
66 GARDEN ST., BRIDGEPORT, CONN.

Pipe Cutting and Threading Machinery, FOR HAND OR POWER, RATCHET DRILLS, RATCHET DIE STOCKS AND MALLEABLE IRON PIPE VISES.



This beats Wind, Steam or Horse Power.

We offer the WEBSTER 2 1-2 ACTUAL HORSEPOWER GAS ENGINE

For $150, less 10 per cent. discount for cash. Built on the interchangeable plan. Built of the best material. Made in lots of 100, therefore, we can make the price. Boxed for shipment, weight 800 pounds. Made for Gas or Gasoline.

☞ *Write for Special Catalog.*

WEBSTER MFG. CO.
1079 W. 15th St., CHICAGO.

Columbia University
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SCHOOL OF MINES,
SCHOOL OF CHEMISTRY,
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SCHOOL OF PURE SCIENCE.

Four years' undergraduate courses and special facilities for graduate work in all departments. Circulars forwarded on application to the Secretary of the University.

"There is but one suggestion we might make—and our desire to criticise would impel us to make more—if we could find anything to make criticisms about, and that is instead of calling this most neat, complete and comprehensive catalogue, 'A Book of Tools,' it should have been called *The* Book of Tools, for it has no equal."

F. E. REED & Co., Worcester, Mass.

"A Book of Tools" is our catalogue. It contains 550 pages, upwards of 2,000 illustrations, and will be sent post paid to any address upon receipt of 25 cents in stamps.

CHAS. A. STRELINGER & CO.
DETROIT, MICH.

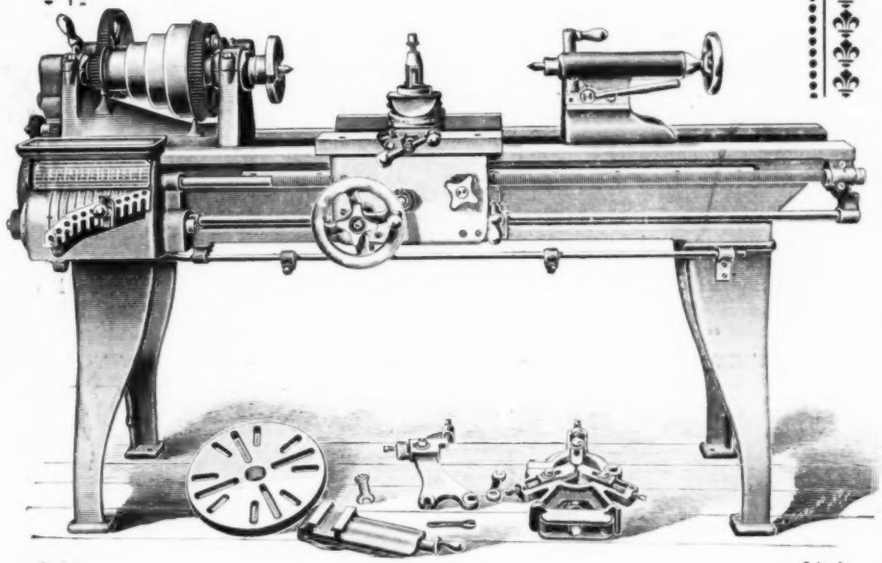
DRILLS.

12" 16" 21" 24" 28" 32" 36" 40" & 44"

The most modern Drill Presses in the market.
Hammered Steel Spindles, Phosphor Bronze Worm-Wheels, Steel Pinions, Etc., Etc.
Our Automatic Stop excels everything of the kind.
Don't buy until you have investigated what we have to offer.
Send for Catalogue.

Built by **The Hamilton Mch. Tool Co.**
Zimmerman Ave., Hamilton, Ohio.

This lathe combines the latest and best improvements.



14″ x 6′ Hendey-Norton Lathe

With Improved Automatic Stop.

Automatic Stop

It is durable, simple, indispensable. It will automatically stop the carriage in either direction. It is equally efficient whether feeding or thread-cutting, running up to a shoulder, boring to bottom of holes, or internal thread-cutting. No danger of spoiling either tool or work. It is a safeguard against accidents in either direction.

Carriage

The carriage reverses in apron; no slamming of countershaft. There is no comparison between this lathe and the old style or common lathe.

Threads

It has all threads in daily use with simple movement of lever.

Feeds

Has all feeds in daily use with simple movement of lever. Send for Circular.

The Hendey Machine Co.,

Torrington, Conn.

European Agents, { Chas. Churchill & Co., London and Birmingham. Schuchardt & Schutte, Berlin, Germany. Eugen Soller, Basel, Switzerland.

(*Continued from page 38.*)

The George Place Machine Co., machinery dealers of this city, have made an assignment.

W. L. Libbey will put in a mill and new machinery on his mining property at Brookfield, N. S.

Gee, Hanson & Co., Barnesville, Ga., will erect a knitting plant, and put in new machinery in this line.

The Patterson Mfg. Co., China Grove, N. C., will install a line of new machinery for their cotton mills.

Knickerbocker Ice Co., Philadelphia, Pa., will put in new and improved machinery in the near future.

The Dennison Say Mfg. Co are having a new factory built at Framingham, Mass., and new machinery will be installed there.

The Waltham (Mass.) Electric Clock Co. are building an addition to their factory, and intend to install new machinery in the same.

Vicksburg, Mich., will expend $120,000 for a new electric light plant. Engines, pumps, electric machinery for lighting and power purposes will be installed.

A new foundry will be built by the Hunt Air Brake Co., of New Kensington, Pa. When finished it will be one of the best equipped in Western Pennsylvania.

The Helliker Planing Co., Bay City, Mich., will rebuild their plant, $60,000 to be expended on new machinery, resaws, matchers, rip saws and mouiders.

The Tatio Mfg. Co. has been organized at Beaver Falls, Pa., with a capital of $30,000, to manufacture the Tatio lamp burner. H. T. Barker, of Beaver Falls, is secretary.

Keller & Server Co., Standish, Mich., will erect a factory and thoroughly equip same for the manufacture of bicycles and findings, engine lathes and other improved machines.

Mr. H. J. Hendey, of Torrington, Conn., has purchased the entire plant of the Alvord & Spear Mfg. Co., of the same town, manufacturers of piano stools, wood bicycle rims, etc.

The city of Chicago is about to install six vertical, triple expansion condensing pumping engines, each capable of lifting 20,000,000 gallons in 24 hours against a head of 150 feet.

A new company, known as the A. M. & W. H. Wiles Co., of Grassey Point, N. Y., has been granted a charter, with a capitalization of $500,000, to engage in a general machine business.

The Tamirack Lumber Co., Houghton, Mich., will expend $170,000 upon the plant to be erected at once. Latest lumber manufacturing machinery, engines, pumps, etc., will be installed.

The Montreal Construction Company is the name of a company seeking incorporation at Montreal, Que., capital $500,000. The building of bridges and railways are the objects of the company.

W. A. Gardner, manufacturer, of Essex, Ont., has decided to secure increased power. A 60-horse power boiler, 50-horse power engine and 150 feet of 2½-inch shafting and hangers will be required.

The Reners Drop Forge Co., of Revere, Mass., are building an addition to their forge shop, 52 x 85 feet, and will fit up the same for bicycle and shoe-tool work. Chas. Robertson is superintendent.

A new iron manufacturing concern has been organized at St. John, N. B., for the manufacture of bar iron and bolts and nuts. It is known as the St. John Rolling Mill and Bolt Works; capitalization $50,000.

It is reported that the works of the Brush Electric Co., at Cleveland, O., are to be removed to Lynn, Mass., and will occupy some of the buildings of the General Electric Co. About 1,100 hands will be employed.

The American Steel Co., of Indianapolis, Ind., are thoroughly overhauling their plant and introducing new machinery. It is the intention of the company to make it one of the best equipped plants in the State.

New shops will be built at Zellenople, Pa., for the Glenn Driller Co., of New Brighton, Pa. When moved to their new plant the company will have doubled their capacity. New machinery will be needed at an early date.

The Glazin Stove Co., Chelsea, Mich., will not henceforth manufacture stoves, but will enlarge their plant and equip same thoroughly for the manufacture of high grade bicycles; $50,000 will be spent on improvements.

Grant Sipp, Hamilton Mill, Mill street, Paterson, N. J., has succeeded A. J. Weed & Co., of New York, and will continue their business in combination with the small engine and boiler business of G. E. Wright, of Newark, N. J.

The Battle Creek, Mich., Implement Co., will rebuild their recently burned plant; $35,000 will be expended to re-equip the plant for the manufacture of farming implements. Engines, power punches, trip hammers, pumps, lathes, drills, etc., will be installed.

At Torrington, Conn., Mr. Eagel, formerly of the Smith & Eagel Mfg. Co., Bridgeport, Conn., has purchased the factory recently used by the Eagle Bicycle Mfg. Co. to engage in the manufacture of a patent eyelet, designed for all sorts of laced shoes, etc.

Alex. Rankine, Thos. Miller, J. S. Crocker, Robt. R. Rankine and A. I. Trueman are asking for letters of incorporation to purchase, sell and manufacture all classes of iron, steel and other metals and wood, at St. John, N. B., under the title of the St. John Rolling Mills & Bolt Works Co., Ltd. Capital $50,000.

The Jarvis Bicycle Saddle Co., Ltd., is the name of a company, under a capital of $20,000, applying for incorporation to manufacture and sell the Jarvis bicycle saddle, to manufacture bicycles and bicycle parts at Toronto, Ont. B. Jarvis, D. O. Jones, R. F. Scott, D. G. Lorsch and Neil McCrimmon are the applicants.

There has been recently organized at Appleton, Wis., the Fox River Acetylene Co., the officers being Mr. Frank Wright, president, Mr. Humphrey Pierce, vice-president, and Mr. I. Rossmeiss, secretary and treasurer. This company is now putting in four Leffel water wheels, and expects to be running within sixty days.

The Moto-Cycle Company of Canada, capital $150,000, to manufacture and deal in all kinds of horseless vehicles, etc., and chief place of business Montreal, Que., have applied for incorporation. The applicants are R. Prefontaine, M. P. Captain, C. J. Q. Coursol, John N. Hickey, Louis Legat, T. F. Moore and Charles Lionais.

The Selkirk Transportation and Cold Storage Company has been recently incorporated with a capital of $50,000. The following are to be the directors: Wm. Robinson, A. E. Richards, F. L. Patton, Winnipeg, Man.; Wm. Overton, Selkirk, Man.; John Coventry, Windsor, Ont., and Hugh Armstrong, Portage La Prairie, Man.

The Vancouver Marine Railway Company, Ltd., capital $500,000, is the name of a new company and new industry at Vancouver, B. C. Pres., Robert Hamilton; vice-pres., W. H. Armstrong; secy.-treas., G. Griffith. A site has been secured near the sugar refinery. A plant and appliances will be erected for the building and repairing of ships.

The New York branch of C. B. Rogers & Co., wood-working machinery, has been succeeded by an agency for the same, in the hands of Mr. W. J. Reddy, who has been for fourteen years in their employ as master mechanic and as general manager for the district, and who will handle also the tools of the United States Machine Company.

As soon as a route is finally decided upon a company will be incorporated to build and carry on an electric railway from Split Rock to Syracuse, N.Y. The Solvay Process Co., of Syracuse, already have an overhead cable system for conveying limestone from the Split Rock quarries to its works, and it is said that some of the influential members of the latter-named company are interested in the new railway. The length of the railway will be about 3½ miles.

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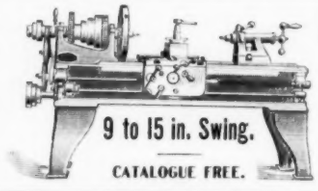

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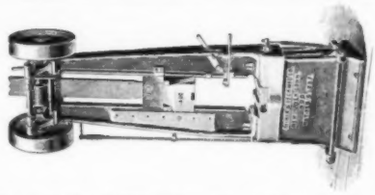

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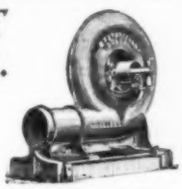

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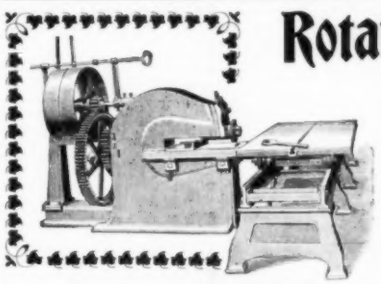

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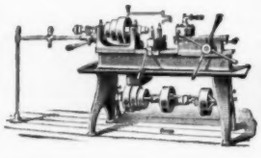

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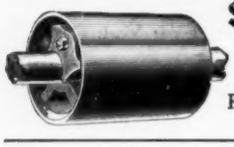

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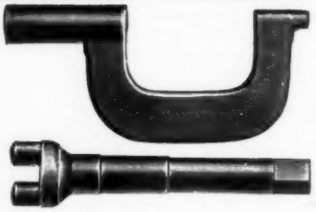

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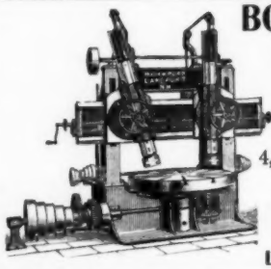

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